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Observations on the Hangul or Kashmir Stag, (*Cervus elaphus hanglu* Wagner)

BY

George B. Schaller
Research Associate, New York Zoological Society and Rockefeller University, U.S.A.

(*With a plate and a text-figure*)

The hangul or Kashmir stag were once distributed widely in the mountains of Kashmir. At present they occur primarily in the 143 sq. km. Dachigam Sanctuary near the city of Srinagar, with possibly a few small populations elsewhere. Little is known about the habits of the hangul, in contrast to the detailed information available on *Cervus elaphus elaphus*, the European red deer (Darling 1937 ; The Nature Conservancy 1967). Most published reports consist of brief accounts by hunters (Ward 1921 ; Stockley 1936) and naturalists (Talbot 1959 ; Gee 1964), the former stressing shooting exploits, the latter conservation problems. Gee (1966) presents a summary of this literature. I spent October 6 to 21, 1968, in the Dachigam Sanctuary to observe the rut of the animals particularly as it compared to other species of *Cervus* deer studied so far (Struhsaker 1967 ; Schaller 1967).

Most hangul spend the summer months from mid-May to mid-September on the alpine meadows and in the pine forests at altitudes of 3000 m. and above, but with the onset of cold weather they move some 15 km. into the valleys, principally the valley of the Dagwan River which remains uncultivated. During my stay, the hangul were concentrated along 6·5 km. of this narrow valley and the adjoining slopes, about 16 sq. km. of terrain. Most of my time was spent within this area. The dense undergrowth, coupled with the scarcity and shyness of the deer, made prolonged observations difficult. Only when the animals ventured briefly onto the open slopes was it possible to watch them undisturbed from a distance with binoculars and spotting scope. Hangul, singly and in groups, were observed on 46 occasions.

The lower portion of the Dagwan River valley lies at an altitude of about 1800 m. Rocky slopes rise steeply on each side. Coarse grasses cover the south-west facing slopes, trees and shrubs being confined largely to ravines, whereas the north-east facing ones are overgrown with the shrub *Parrotia jacquemontiana* and stands of *Pinus excelsa*. A mixed deciduous forest with an uneven canopy grows in the valley and on the lower slopes. Mulberry (*Morus* sp.) is the most abundant tree ; stands of *Populus* sp., *Quercus* sp., and *Salix* sp. are common, and *Celtis australis*, *Juglans regia*, and others occur throughout. Undergrowth is dense, except for a few glades, with such shrubs as *Rosa* sp., *Rubus* sp., *Indigofera geradiana* and *Parrotia jacquemontiana* predominating.

Population size and composition

Hangul appear to have declined drastically in recent years. Gee (1966) estimated that perhaps 2000 still existed in 1947 ; after a visit in 1957 he thought 400 survived, and in 1965 only 180. The figures used by the Kashmir Forest Department are 550 hangul in 1958, 250 in 1960, 360 in 1962, 280 in 1965, and 384 in 1968. Since no adequate census has ever been conducted, all figures are at best rough estimates. I was unable to census the total population in the time available because a number of deer were still on the high ridges, as revealed by an occasional set of tracks there. For example, I saw the tracks of one stag in the snow at an altitude of 3600 m. on October 19. Tracks were common in the study area, confirming a concentration of animals.

A total of 86 hangul were seen in the study area, some of them several times. Rutting stags were particularly conspicuous because they roared at intervals. The largest number of stags heard calling during any one morning or evening was 7. Six stags were recognized individually by peculiarities in the tine pattern of their antlers, and repeated encounters with these animals indicated that the same ones were heard day after day. An estimated 15 to 20 stags used the study area. Most stags were solitary or had at most 2 or 3 hinds with them (see below). This, together with the fact that I failed to find hinds or their tracks in appreciable numbers elsewhere, suggests that they were no more abundant than the stags. In addition, several hinds were accompanied by fawns. The total number of deer in the lower part of the Dagwan valley was about 50. A few more deer undoubtedly drifted into the valley later in the season. In February, 1965, an estimated 160 wintered there, according to the Forest Department, but I doubt if that many remained in 1968.

Small hangul populations are said to winter in other valleys. A total of 97 were supposed to have been in the Tral area in 1965 (Gee 1966). I visited this heavily cultivated valley for 2 days and found no sign of deer.

I am unable to give an accurate population estimate, but agree with Gee (1966) that there are probably 180 or fewer hangul left in existence.

Of the 86 deer observed, 44 were stags, 29 were hinds, and 13 were fawns, giving ratios of 151 males : 100 females ; 45 young. Thirty-eight of the stags were large (antlers with 8 to 12 points), 2 were small (6 points), and 4 were yearlings (2 points). The male to female ratio probably does not reflect the population composition accurately because roaring stags are more easily spotted by the observer than the silent hinds. Males and females appeared to be present in about equal numbers. Stockley (1936) noted a male to female ratio of 30 : 100, and a census in 1965 gave one of 9 : 100 (Gee 1966), but the accuracy of the latter figure is questionable. Nearly half of the hinds were accompanied by young, indicating good fawn production and survival. Red deer hinds give birth to their first young when 3 or 4 years old and then either breed each year or in alternate years (Darling 1937), a pattern probably followed also by the hangul. Some hinds in my sample may have been yearlings and had not yet given birth to their first young, so the per cent of fawns in relation to adult hinds would be somewhat higher than indicated.

Group size and composition

During the rut, red deer form breeding herds consisting of one large stag with as many as 50 hinds and fawns (Darling 1937). Hangul appear to follow the same basic pattern, except that too few are left to form large herds. Rutting stags were seen 38 times. Twenty-five times (65%) they were alone, and 13 times (35%) one or more hinds accompanied them. The largest number of hinds with a stag was 3, the average 1·5. The size of 13 breeding herds varied from 2 to 5, and included one large stag, one or more hinds, occasionally a fawn, and on 3 occasions a young stag or two. Sixty-nine per cent of the hinds associated with large stags. Single hinds, alone or with a fawn, were seen 3 times. Gee (1966) encountered one herd consisting of 3 stags and about 30 hinds and fawns in February, 1965. Although hangul may have been more abundant at that time, it is also possible that the small groups congregated into a few large herds after the rut as has been observed in the chital (*Axis axis*) by Schaller (1967).

Rutting behaviour

Roaring by stags was the most conspicuous feature of the rut. A calling stag raised his muzzle slightly and through partially open mouth emitted a sound which, at a low intensity, resembled a groan. At a high intensity it consisted of a loud, resonant bugle—*eeeoouuuuu*, *eeeuuuuu*, or *uueeeuuuu*—beginning harshly and ending on a clear, deep note dropping progressively in pitch. A roar by one stag frequently stimulated one or more others to respond similarly, and the animals then called back and forth, sometimes for half an hour or more.

A total of 941 roars were heard in the study area between dawn shortly after 06.00 hours and dusk at 18.00 hours. Calling reached daily peaks between 06.30 and 08.00 hours and between 16.00 and 17.30 hours (Fig. 1). Calling was also heard at night. Only large stags (8 or

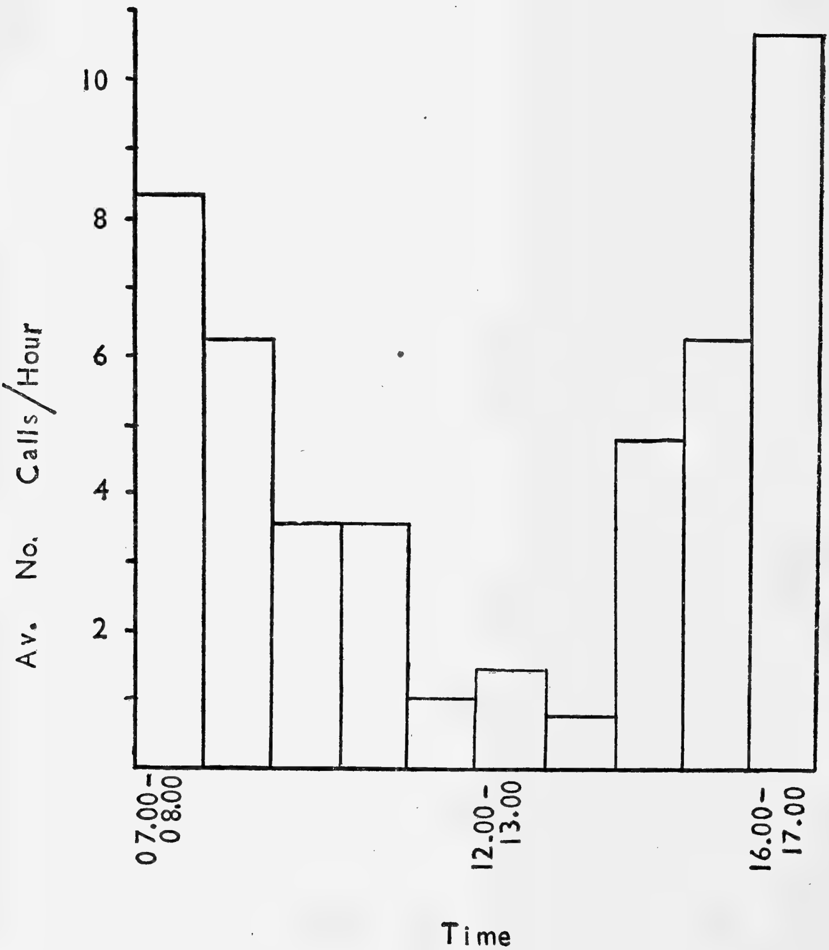

Fig. 1. Average number of calls by stags heard in the study area at hourly intervals, 07.00 to 17.00 hours.

Schaller : Kashmir Stag

A stag in the Dachigam Sanctuary

(*Photo : Author*)

more points) roared. These had dark brown, swollen necks, in contrast to the grey-brown slender necks of young stags.

Forester Kaul told me that he heard the first roars of the season on September 25 ; they were common when I began observations on October 6. The frequency of calling varied considerably from day to day and appeared to be correlated with weather. For example, on October 9, a clear, warm morning, stags were heard roaring 7 times between 06.30 and 08.00 hours. The following morning, a rainy, cool one with snow falling on the hills, they called 50 times. Similarly, on October 12, a clear day, only 18 calls were noted between 06.30 and 08.00 hours ; the next day, a cloudy one, 62 calls. Darling (1937) also noted the influence of weather on the amount of bugling in red deer. After October 17, the number and intensity of roars decreased noticeably, indicating that the peak of the rut had passed. Occasional roars can be heard until early November, according to the local forest staff. The peak of the rut appeared to be during the second week of October, somewhat earlier than the October 20 stated by Gee (1966). With a gestation period of 230 to 240 days (Walker 1964), most young would be born in late May, with a range from mid-May to mid-June, not in April as noted by Prater (1965).

Solitary rutting stags appeared restless as they wandered along the slopes, stopping occasionally to roar or to sweep their antlers with upward and lateral motions through a shrub for as long as 5 minutes, leaving the bark shredded and branches tattered. Most stags confined themselves to a definite part of the valley where I saw them repeatedly. Areas were, however, not exclusively occupied by one stag. One slope was frequented by 3 large stags, but usually not at the same time. On one occasion, a stag, accompanied by 2 hinds and a fawn, roared repeatedly and was answered by two stags nearby. One of these approached, and, hidden behind shrubs, watched the stag with the hinds from a distance of 100 m. briefly before leaving. The stag then left the hinds and angled into the valley where the third stag called in a thicket 0·5 km. away. Both stags roared intensively, and, on creeping close to them, I could see one lying beneath a tree while the other 60 m. away thrashed a shrub vigorously with his antlers.

Courtship behaviour was seen on 8 occasions. The stag typically stayed close to the hind. When she walked, he followed ; when she browsed, he stopped too, standing behind or parallel to her, his body held erect. At times he roared or swept his antlers through a bush. One stag and hind, watched from 07.30 to 17.00 hours, remained together all day, resting most of the time. At 16.10 hours, the stag placed his chin on her rump, then mounted for 5 seconds.

Rutting stags tolerated young stags in their vicinity. Once, a courting stag showed no response when a yearling stag and a second hind left the group. On another occasion, a large stag ignored 2 young stags even though they stood only 15 m. from the hind he was courting. But when one advanced to within 6 m., the large stag took a step toward him, causing him to retreat.

The hinds appeared to drift from stag to stag without remaining with one for long. Stags which one day were with a hind, were often alone the following day. Two hinds and a fawn were with one stag ; 2 days later seemingly the same 3 animals were with another stag.

Conservation

Gee (1966) ably pointed out the many problems besetting the hangul in the Dachigam Sanctuary. The summer range of the deer is heavily stocked with cattle, sheep, and goats. One area, the Sangergulu basin, seems to be overgrazed, with erosion becoming apparent. Competition for browse and grass between deer and domestic animals may become acute as the livestock increases, and diseases like rinderpest could be transmitted to the hangul. Fortunately grazing pressure is light in the Dagwan River valley where most deer spend over 7 months of the year. However, human disturbance in their winter range is excessive with road workers, grass cutters, illegal wood collectors, and the staff of the rest house, sheep farm, and trout hatchery all wandering around the narrow valley. The rutting deer were frequently disturbed.

The most important and urgent problem threatening the survival of the hangul is poaching. During my first week in the sanctuary, I found a poachers' camp where a carcass had been butchered the previous day, and twice observed persons in military uniform accompanied by villagers shoot at deer and miss them. Shots were also heard on several other occasions. Rutting stags are particularly vulnerable to being poached because they are inattentive. Three times I stalked to within 20 m. of a stag before being detected. The Kashmir Forest Department makes no sustained effort to control poaching. Unless this is done, the hangul is certain to become extinct in the wild.

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The Birds of Sind: A Review

BY

D. A. HOLMES AND J. O. WRIGHT

[*Continued from Vol.* **65** (3) : 556]

Larus hemprichii Bruch. Sooty Gull

This gull was common in Karachi harbour in mid-April, but Ticehurst states that it is found there throughout the year, except in July (when they are breeding on the island of Astola, off the Mekran Coast).

Larus argentatus Pontoppidan. Herring Gull

Larus fuscus Linnaeus. Lesser Blackbacked Gull

The larger gulls are common visitors to Karachi harbour, and immature gulls of uncertain species were occasionally seen in Lower Sind in winter (up to mid-April).

Larus ichthyaetus Pallas. Great Blackheaded Gull

This fine gull seems to be common in some winters only. It was very common on Kalri Lake in February and March 1963, but we have comparatively few subsequent records. Ticehurst saw it only once, on Manchar Lake.

Larus brunnicephalus Jerdon. Brownheaded Gull

Larus ridibundus Linnaeus. Blackheaded Gull

Common visitors, inland and on the coast, leaving in April (latest date, May 16). The Blackheaded is generally much the commoner bird.

Larus genei Brème. Slenderbilled Gull

Seen occasionally at any season in small numbers, on the coast, and inland in Lower Sind, on two occasions as far north as Hyderabad. However, Roberts reports that they sometimes extend north to Manchar Lake and even to Kandhkot.

Chlidonias hybrida (Pallas). Whiskered Tern

The status of the Whiskered Tern in Sind is not clear. It is mainly a passage migrant and winter visitor, with quite large parties lingering through to early June in the south. We have no knowledge of breeding in Sind, although they may perhaps still do so in some years, and the jheels along the Eastern Nara would be worth investigation at this season.

Gelochelidon nilotica (Gmelin). Gullbilled Tern

A common tern on the coast, it is seen more rarely inland, in Lower Sind in small numbers between mid-August and mid-May. According to Roberts it even occurs at Kandhkot in Upper Sind.

Hydroprogne caspia (Pallas). Caspian Tern

Seen occasionally in very small numbers in Lower Sind, mostly in winter, but a few linger on through the summer, and Roberts has seen them at Kandhkot in autumn, disappearing when the pools begin to dry out.

Sterna aurantia J. E. Gray. Indian River Tern

Probably the commonest tern in Sind, breeding on the Indus sand-banks in April and May, and wandering widely over the canal system and jheels when the river rises in June, and in winter.

[**Sterna hirundo** Linnaeus. Common Tern

Not positively identified, but birds thought to be this species were seen in May, July and September along the Indus and at Kalri Lake.]

Sterna acuticauda J. E. Gray. Blackbellied Tern

The other common and resident tern of Sind, with a status and distribution similar to the Indian River Tern.

Sterna albifrons Pallas. Little Tern

Apart from the coastal strip, the Little Tern is rather sparse in Sind but is apparently resident in small numbers along the Indus, probably breeding with the other resident terns, spreading out to some jheels later in the summer (they are quite common at Kalri Lake from June to August).

[**Sterna** sp. Sea Terns

We visited the coast infrequently and have little knowledge of the sea terns, but both Crested Terns (*Sterna bergii* and *S. bengalensis*) were common in Karachi harbour in October and April, and the Sandwich Tern (*S. sandvicensis*) was also present in April.]

Rynchops albicollis Swainson. Indian Skimmer

The Skimmer has been known to breed on the Indus, but is now apparently rare, and our only records are of small parties flying south along the river at Hyderabad on July 27 and September 5, 1965. Its status is uncertain, but it must be remembered that most of the Indus itself is rather inaccessible.

Pterocles exustus Temminck. Indian Sandgrouse

This is the only species of sandgrouse that we positively identified, and it is a common resident in the jebel regions and desert areas, including areas of scrub-land within the cultivated plains. The Coronetted Sandgrouse (*P. coronatus*) was suspected on several occasions, in jebel areas, but never confirmed, while Roberts considers the Painted Sandgrouse (*P. indicus*) to be a resident in rocky foothills and thorn scrub in S.W. Sind.

Columba livia Gmelin. Blue Rock Pigeon

Very common especially near buildings. We have no records of either the Eastern Stock Pigeon (*C. eversmanni*) or the Wood Pigeon (*C. palumbus*).

Streptopelia decaocto (Frivaldszky). Collared Turtle Dove

Abundant and widespread throughout the plains.

Streptopelia tranquebarica (Hermann). Red Turtle Dove

Widely but rather sparsely distributed over the wooded and more fertile districts. It is largely a summer visitor, although some may be resident, as we have seen them in the north early in February.

Streptopelia senegalensis (Linnaeus). Little Brown Dove

Probably as common as *S. decaocto*, and more willing to extend into desert scrub.

Psittacula eupatria (Linnaeus). Large Indian Parakeet

Ticehurst only knew this parakeet in Karachi, suggesting that they were descendants of escaped captive birds. However, Eates (1937) stated that they are common in Lower Punjab, and that it is a common breeding resident at Ubauro, just within Sind. He described small flocks wandering south in November, to about the level of Nawabshah, and forecasted that the spread of canals may allow an extension of range.

On July 17, 1964, there was an influx of some 50 birds along the first half-mile of the tree-lined Nara Canal below Sukkur. They became more dispersed over the following few weeks, but odd birds were still seen in September, and 2 were seen in Hyderabad on November 2. At least 2 were present in a well-timbered, overgrown garden beside the Sukkur-Chak river bund on April 15, 1965. Unfortunately we were stationed in Hyderabad in 1965, and were unable to establish whether they were breeding in the Sukkur area.

Psittacula krameri (Scopoli). Roseringed Parakeet

Abundant throughout the well-timbered parts of Sind.

Clamator jacobinus (Boddaert). Pied Crested Cuckoo

A common summer visitor to damp wooded areas and thickets, arriving most regularly at the end of the first week of June, leaving in September. It is perhaps on the increase, as Ticehurst knew of no records from Upper Sind, whereas Eates (1937) found them common at Jacobabad. We found them to be especially common in the flooded riverain areas at Sukkur.

Cuculus canorus Linnaeus. Cuckoo

Our only definite record is of one near Jacobabad on April 10. Ticehurst described it as a passage migrant, not wintering in Sind.

Eudynamys scolopacea (Linnaeus). Koel

The northward spread of the Koel has been well documentated by Ticehurst, and by Eates (1937 and 1938). It is now very common in Lower and Central Sind, but is still perhaps rather scarce in Upper Sind, and only a visitor there (in Sukkur in 1964, none were heard until mid-May, whereas they begin to call at the end of March in Lower Sind). It is not known for certain whether it is entirely resident in Sind, and some may be only summer visitors, but the bubbling call may be heard occasionally throughout the winter in Hyderabad and Karachi.

Taccocua leschenaultii Lesson. Sirkeer Cuckoo

This seems to be a very rare bird in Sind. It was virtually unknown in Ticehurst's time, but is evidently spreading, for Menesse (1939) saw it in several places in the Hyderabad-Shahdadpur area. We saw solitary birds on three occasions, in desert scrub on the edge of the sandhills at Nabisar, and beside the Mithrao Canal near Jhudo, in August, and beside the Pinyari near Sujawal, in April. Roberts says that it is resident in thorn scrub at Malir, near Karachi.

Centropus sinensis (Stephens). Coucal

Common resident along canal bank thickets and around jheels throughout the plains, its call can be heard at any season.

Tyto alba (Scopoli). Barn Owl

A good account of the resident owls of Sind is given by Eates (1939). The Barn Owl is evidently pretty rare, and we found only one bird, in a tomb in a ruined village site in very barren country between Badin and Jati, in May 1963. A second bird could not be found. We never specifically searched old tombs for Barn Owls, and probably missed several more as a result.

[**Otus brucei** (Hume). Striated Scops Owl

Otus scops (Linnaeus). Scops Owl

There are very few records of either of these owls in Sind, and we have no knowledge of them. *O. brucei* is evidently a rare resident, which Eates saw only three times in 18 years.]

Otus bakkamoena Pennant. Collared Scops Owl

Ticehurst and Eates found this owl not uncommon in the better-wooded parts of Sind, but we did not become aware of it until 1965, in Miani Forest and along the Pinyari Canal, both near Hyderabad, and near Sukkur. It is difficult to find unless the call is listened for at night, for they tend to sit motionless by day (J.O.W. was sitting in an overgrown garden for nearly an hour before noticing a pair of these owls quietly watching him, motionless, from the next tree).

Bubo bubo (Linnaeus). Eagle-Owl

According to Eates (1937 and 1939), the Eagle-Owl is not uncommon in the dry hilly tracts (and in the Thar Desert east of Umarkot), and habitat dictates that owls of *Bubo* sp. seen by us at Kot Diji and Pir Patho, and reported to us from the Gaj gorge, were of this species. Eates knew of only two records in the plains, away from the typical habitat, at Mirpur Mathelo (near Sukkur), and a nest reported by Ticehurst near Badin.

During the summer of 1965, we watched several Eagle-Owls, recognized by their quite distinct call, along a four-mile stretch of the Pinyari Canal, up and down stream from the Hyderabad-Tando Muhammed Khan road crossing. We first found 2 on May 8, and saw or heard them subsequently on each evening visit (until visits ceased in September), and there may well have been 5 or 6 birds present along this stretch. They may have been 3 pairs, or a single family dispersed from the previous winter's breeding season. Of all the sites where this owl might occur in the plains, this is perhaps the most ideal. The site is only 2 or 3 miles from the low jebel of Ganjo Takar ; the deep, wide Pinyari and Fuleli Canals run side by side, with very high spoil banks covered with dense thickets between them.

Bubo coromandus (Latham). Dusky Horned Owl

This is the commonest of the genus, according to Ticehurst and Eates, in the forest, riverain and canal tracts, but we have only one definite record, of a pair in the riverain forest above Hyderabad (although other owls seen in the Badin and Jati areas were presumed to be of this species), and we never heard the call. However, it is probably quite a common bird which we have overlooked.

[**Bubo zeylonensis** (Gmelin). Brown Fish Owl

This very rare owl, never found by Ticehurst, and seen only twice in 18 years by Eates, evaded us, although D.A.H. has an unconfirmed record from flooded tamarisk at Muradani in December, 1965.]

Athene brama (Temminck). Spotted Owlet

The commonest owl in Sind, and certainly the most conspicuous by day, throughout the cultivated plains, in woods, gardens, tree-lined canals etc., and even amongst buildings in Sehwan. Oddly, we rarely heard it, despite countless nights spent in rest house gardens.

[**Asio otus** (Linnaeus). Longeared Owl

We never saw this uncommon winter visitor].

Asio flammeus (Pontoppidan). Shorteared Owl

Our only record is of 3, perhaps 4, in open fields at Usta Mohammed, on February 21.

[**Caprimulgus europaeus** Linnaeus. European Nightjar

We failed to identify this nightjar, said by Ticehurst to be a common passage migrant in spring and autumn].

Caprimulgus mahrattensis Sykes. Sykes's Nightjar

The commonest nightjar of Sind, found on open ground or in bare scrub in the plains. We never saw it perch in trees. The note is a low churring or purring on one note, sometimes continuous, and slightly similar to *C. europaeus*, but only audible at very close range except on a still night.

Caprimulgus asiaticus Latham. Common Indian Nightjar

Ticehurst knew of only one or two winter records of this species from Sehwan. Eates (personal communication) collected an egg near Sujawal in 1935. Its range would appear to be spreading (probably from the south-east), for it can now be heard commonly in Lower Sind. We found it common at Sirani (south of Badin), Jati, Ladiun, Muradani Dhand and beside the Ganjo Takar jebel south of Hyderabad (our most northerly record), and Roberts heard it at Malir (near Karachi). The call can be heard at any season.

Apus apus (Linnaeus). Swift

One Pallid Swift (*A. a. pallidus*) was seen near the Karachi rubbish tip on April 18, 1965. Another solitary swift, probably *A. a. pekinensis*, was seen at plains level along the Hyderabad-Sehwan road, between the Lakki Hills and the Indus, on August 13, 1965. Although *A. a. pekinensis* has never been definitely identified in Sind, it is not unreasonable that it might occasionally straggle down from the hills of Baluchistan where it is said to breed.

Apus affinis (J. E. Gray). House Swift

Very common in towns, but as Ticehurst noted, the majority appear to leave for the winter, more especially perhaps from Upper Sind, returning in February.

Ceryle rudis (Linnaeus). Lesser Pied Kingfisher

Very common throughout the canal system, and around jheels.

Alcedo atthis (Linnaeus). Common Kingfisher

This is the least common of the three kingfishers. It is quite common in winter, but small numbers are resident about canals and jheels.

Halcyon smyrnensis (Linnaeus). Whitebreasted Kingfisher

Not as common as the Lesser Pied Kingfisher, but more widely distributed, being less confined to canals and edges of pools.

[**Merops apiaster** Linnaeus. European Bee-eater

There are very few records of this bird in Sind, and we never saw it.]

Merops superciliosus Linnaeus. Bluecheeked Bee-eater

The distribution of this bird in Sind has been described by Ticehurst, and by Eates (1939). Although *M. philippinus* is the commoner species in the Punjab, we believe that *M. superciliosus* is the usual form in Sind. It is a very common passage migrant, arriving in April, probably from the west (our earliest record is of 7 flying east near Jacobabad on April 10). They are widespread in May, especially near water although some are also found in desert areas. Only odd birds are seen through the summer, but we found them generally distributed over the reed-beds at Jamraohead on May 11, where coitus was observed. Parties seen in mid-August about the Bahmanabad ruins (near Nawabshah), around Manchar Lake, and in rocky desert south of Sehwan, suggest other possible breeding sites, as the return passage does not begin until later in August. They are widely distributed again in September and October, the last stragglers being seen in mid-November.

Merops orientalis Latham. Green Bee-eater

Very common and widely distributed in well-timbered areas.

Coracias garrulus Linnaeus. European Roller

Solitary birds were seen at Hyderabad on September 19 and 26 (and by Roberts on September 3 near Karachi). It is a scarce passage migrant.

Coracias benghalensis (Linnaeus). Indian Roller

Common and generally distributed resident.

Upupa epops Linnaeus. Hoopoe

A common winter visitor and passage migrant, arriving in late-July, and leaving in late-march. Earliest dates are July 20 (1964, Larkana), and July 18 (1965, Tatta) and the latest date is April 4. They may be encountered in bare desert on migration. We have never heard it call in Sind. These birds appeared to have very little white in the crest, and certainly less than in the breeding form in the hills at Quetta.

[**Megalaima haemacephala** (P. L. S. Müller.) Crimsonbreasted Barbet

Ticehurst notes two records of this bird, which we never found.]

Jynx torquilla Linnaeus. Wryneck

3 winter records, at Dabeji (near Karachi) on October 16, and near Sukkur and Hyderabad in February.

Dinopium benghalense (Linnaeus). Lesser Goldenbacked Woodpecker

Common in well-timbered areas.

Dendrocopos assimilis (Blyth). Sind Pied Woodpecker

Common, and more prone to venture into less wooded country than the previous species. We did not confirm whether or not it occurs in the south-east,where Eates (1937) states that it is replaced by the next form, but the ranges of the two species certainly overlap in the Hyderabad area.

Dendrocopos mahrattensis (Latham). Yellowfronted Pied Woodpecker

Eates (1937) has described this bird's range in S.E. Sind. We have seen it at Naukot, Mirpur Batoro, and by the Pinyari a few miles below Hyderabad. Apparently it is restricted to this zone ; we were unable to find it in Miani Forest at Hyderabad, or in a wooded area south of Jamraohead, but Eates recorded it at Mirpur Sakro, Mirpur Khas, and as far north as Sakrand (nearNawabshah).

[**Mirafra javanica** Horsfield. Singing Bush Lark

Sind is included in the range of this lark in Ripley, but Ticehurst recorded only one bird, near Karachi, and we have no knowledge of it.]

Mirafra erythroptera Blyth. Redwinged Bush Lark

This is probably not uncommon in areas of desert scrub, although we have few records only, from near Tando Bago in the south-east, west of Hyderabad, and near Karachi.

Eremopterix grisea (Scopoli). Ashycrowned Finch-Lark

Eremopterix nigriceps (Gould). Blackcrowned Finch-Lark

These finch-larks are common, especially the Ashycrowned, which likes both desert scrub and dry cultivation, and little flocks of 4 or 5 are seen commonly along dusty field roads and near villages. The Black-crowned is less common, and is perhaps confined to desert areas.

Ammomanes deserti (Lichtenstein). Desert Finch-Lark

Restricted to jebels. It was found to be quite common at Kot Diji and Roberts states that it is a common resident in the lower parts of the Khirtar Range.

[**Ammomanes phoenicurus** (Franklin). Rufoustailed Finch-Lark

We have no knowledge of this bird in Sind.]

Alaemon alaudipes (Desfontaines). Hoopoe-Lark

Very locally distributed, we saw this bird only in the Pat Desert (along the Jacobabad-Sibi Road), south of Sehwan, and in the margins of the cultivated areas south of Badin and Jati. In these desert plains (the Pat Desert is almost totally devoid of vegetation), they are not uncommon, and ones or twos can be seen every half-mile or so.

Calandrella cinerea (Gmelin). Short-toed Lark

A common winter visitor, in parties or quite large flocks, mostly to areas of desert scrub.

Calandrella raytal (Blyth). Sand Lark

Quite common along the Indus, and occasionally around the bare margins of pools. Roberts found it common in the sand dunes near Karachi.

[**Melanocorypha bimaculata** (Ménétries). Eastern Calandra Lark

We have no knowledge of this lark, but earlier records suggest that it may be a not uncommon winter visitor to Upper Sind and the Thar Desert.]

Galerida cristata (Linnaeus). Crested Lark

Very common, both as a resident and as a winter visitor, in most lowland habitats.

Alauda sp. Skylarks

The status of the skylarks in Sind is not very clear. *A. gulgula* appears to be a rather local resident, in the more fertile districts and in clearings in the riverain forests.

Riparia sp. Sand Martins

The two species of Sand Martin were not always readily separated, but the Plain Sand Martin (*R. paludicola*) is a very common resident, while the Collared form (*R. riparia*) is probably only a winter visitor. Ticehurst stated that the Collared Sand Martin leaves in March, but we saw large flocks of apparently this species along telegraph wires in Upper Sind in mid-April in both 1964 and 1965, and in the reeds of Jamraohead on May 11.

Hirundo obsoleta (Cabanis). Pale Crag Martin

Probably resident in the foothills of the Khirtar Range, seen at heights from about 500 feet upwards.

Hirundo rustica Linnaeus. Swallow

In general, a very common visitor and perhaps also passage migrant, but its movements seem to be very irregular, and not as well defined as Ticehurst suggests. They were common in the Hyderabad-Badin area on June 22, 1963, and again throughout August. In 1964, in the Sukkur area, they were rather scarce in the winter and spring, and although odd birds were seen through the summer, they were not common again until September.

In 1965, about 100 birds had arrived along the bund at Kalri Lake by June 27, and by July 25 they were widely distributed in the Hyderabad area. There were perhaps a thousand on the Kalri bund on August 1. (However, Ticehurst states that they do not reach Lower Sind until September or even October).

Hirundo smithii Leach. Wiretailed Swallow

Common along canals, favouring the arches of canal bridges for its nests. In Upper Sind, it is a summer visitor only, arriving at the end of February or in March. Odd birds may be seen as early as February 2. In Lower Sind, a certain proportion are resident.

Lanius excubitor Linnaeus. Grey Shrike

Resident and locally common, in dry cultivated or marginal areas and desert scrub.

Lanius vittatus Valenciennes. Baybacked Shrike

Resident; commoner than the previous species, preferring more fertile or wooded areas.

Lanius collurio Linnaeus. Redbacked Shrike

A fairly common winter visitor from mid-September to early March, to a variety of habitats from desert scrub to gardens. They were apparently the *phoenicuroides* and *isabellinus* forms and we did not identify *L. c. collurio*.

Lanius schach Linnaeus. Rufousbacked Shrike

Resident and common, in the same habitat as the Baybacked but also extending to drier areas of scrubland.

Oriolus oriolus (Linnaeus). Golden Oriole

Two single males, seen along tree-lined canals in the Eastern Nara area, on August 20 and 26, 1963, are our only records, and it is presumably a scarce passage migrant only.

Dicrurus adsimilis (Bechstein). Black Drongo

A common and widespread resident, breeding in June. Sometimes quite large feeding concentrations are found, for example near livestock, a fire, or over dried-out reed beds.

[**Sturnus pagodarum** (Gmelin). Blackheaded Myna

Ticehurst saw this myna around Karachi, but we never found it in Sind.]

Sturnus roseus (Linnaeus). Rosy Pastor

A very abundant passage migrant, but few stay the winter ; and then only in Lower Sind (probably more in Karachi than in Hyderabad). The northward passage begins in late-February or early-March in the Hyderabad area, lasting until mid-or late-April. In Sukkur in 1964, the spring passage lasted from April 5 to May 4. We were astonished to find that the return passage was already in full swing by June 24, reaching enormous numbers in July (probably millions in the riverain forests just north of Sukkur), fading off at the end of July but with a subsidiary peak in the second week of August. They seemed to advance southwards in steps or overlapping waves, (the immatures following a little later) reaching Lower Sind some time in August. A few stragglers remain at Sukkur until about October, and all the winter in the Hyderabad area.

Sturnus vulgaris Linnaeus. Starling

A fairly common winter visitor and perhaps, in Upper Sind, passage migrant (for a slight influx was noted in early February 1964 around Sukkur), arriving late and leaving rather early. The smaller Sind race, *S. v. minor*, is, however, resident, and can be seen fairly commonly through the summer in flooded tamarix scrub etc. around jheels or in the riverain forests ; as Ticehurst says, they may, however, be rather local.

Acridotheres tristis (Linnaeus). Common Myna

Abundant and resident.

Acridotheres ginginianus (Latham). Bank Myna

A common resident, but rather local (especially in the breeding season in March and April), favouring the riverain tracts and more lush grazing land. In late summer, they were roosting in large numbers with the Rosy Pastors.

Dendrocitta vagabunda (Latham). Indian Tree Pie

Common throughout the well-wooded tracts.

Corvus splendens Vieillot. House Crow

Ubiquitous.

Corvus corax Linnaeus. Raven

A fairly common winter visitor in parts of Upper Sind, leaving about mid-March. Prior to this date, flocks of 100 or so were seen along the edge of the Pat Desert near Jhatpat. Occasionally they can be seen in summer, for example at Kot Diji, where they may be breeding in the jebel. Two were seen at a Sukkur rubbish tip on April 4. We never saw any in Lower Sind.

Tephrodornis pondicerianus (Gmelin). Common Wood Shrike

Resident and quite common in well-timbered areas, but rather easily overlooked.

[**Pericrocotus ethologus** Bangs & Phillips. Longtailed Minivet

A female minivet, probably of this species, was seen in Miani Forest at Hyderabad in February, but the record was not confirmed. It is probably an uncommon winter visitor. The Rosy Minivet (*P. roseus*) has been recorded by Ticehurst at Karachi.]

Pericrocotus cinnamomeus (Linnaeus). Small Minivet

Fairly common resident in riverain forests and well-timbered areas, and even in more desert areas where hollows hold clumps of acacia trees.

[**Pericrocotus erythropygius** (Jerdon). Whitebellied Minivet

Sind is included in the range of this minivet, but it must be very local, or only a straggler, and we have no knowledge of it.]

Pycnonotus leucogenys (Gray). Whitecheeked Bulbul

An abundant resident, found anywhere from waterlogged thickets to bare desert scrub in the hills.

Pycnonotus cafer (Linnaeus). Redvented Bulbul

This bulbul is resident in the East Nara Canal area, at Karachi (probably from escapes), and at Multan in the Punjab. However, its range in Sind may be diminishing, for it was a common resident in the rest house garden at Sindri in the last century, and Eates (personal communication) found it to be quite common at Mirpur Khas, Samaro, Digri and Umarkot in 1936. We travelled widely in this area, but found it only at Naukot, adjacent to the Thar Desert, where it was not uncommon. We were surprised to find a pair in a small orchard and garden at Sukkur in May 1964, which remained for the rest of the year, but just possibly these were escaped birds.

Chrysomma sinensis (Gmelin). Yelloweyed Babbler

Fairly common locally, in damp thickets, canal-side vegetation etc. ; recorded from the Sukkur area, Kandiaro, Hyderabad, Sujawal, Samaro, and Jhudo.

[**Chrysomma altirostre** Jerdon. Jerdon's Babbler

We spent much time in dense grass jungle between Sukkur and Shikarpur, the type locality of *C. a. scindicum,* but were unable to locate it. In 1930, Eates (personal communication) found a nest with two eggs by the Eastern Nara near Sukkur, and later saw birds near the type locality.]

Turdoides caudatus (Dumont). Common Babbler

An abundant bird in cultivation, thickets, and even desert scrub, in the plains and the jebels. Rare or absent in forests and swamps.

Turdoides earlei (Blyth). Striated Babbler

Replaces the previous species in swampy ground, where it is very common.

[**Turdoides malcolmi** (Sykes). Large Grey Babbler

Ticehurst was doubtful of the validity of some previous records of this bird from Sehwan, although strangely one record is quoted by Ripley.]

Turdoides striatus (Dumont). Jungle Babbler

Common resident ; its favourite habitat is the riverain forests, but it occurs in any well-timbered country, generally avoiding scrub.

Muscicapa striata (Pallas). Spotted Flycatcher

Apparently an uncommon autumn passage migrant. One seen at Dabeji spring (east of Karachi) on October 10, and another in Miani Forest near Hyderabad on November 6.

Muscicapa parva Bechstein. Redbreasted Flycatcher

According to Ticehurst, this is more of a passage migrant, especially in spring, than a winter visitor, the spring passage lasting from late-March to mid-April. The majority of our records are from rest house gardens, within the period February 6 to April 17, and few such gardens of any size are without them in this period; but they were also found in the riverain forests and other wooded areas. At Usta Mohammed rest house, near Jacobabad, they were decidedly common at the end of March, and apparently already paired-off. We have only few autumn records.

Rhipidura aureola Lesson. Whitebrowed Fantail Flycatcher

Fairly common in damp, vegetated places all over Sind, occurring also in the riverain forests, tree-lined canals, gardens etc. In Ripley's SYNOPSIS Sind is not included in the range of any species of *Rhipidura.*

[**Terpsiphone paradisi** (Linnaeus). Paradise Flycatcher

Apparently a rare winter visitor to Sind, but we never saw it.]

Cettia cetti (Marmora). Cetti's Warbler

Found to be not uncommon in the winter of 1963-64, in reed beds or grass and tamarix jungle by water, at Jati, and Habibkot near Sukkur, from mid-December to February.

Lusciniola melanopogon (Temminck). Moustached Sedge Warbler

A commoner winter visitor than the Cetti's, seen at the same places and dates, and in similar habitat. Also seen in 1965 (last date, April 4, near Sujawal). On March 1, 1964, they were very common in the Habibkot reed beds, and surprisingly in full song.

Cisticola juncidis (Rafinesque). Streaked Fantail Warbler

Quite a common resident, but perhaps rather local; in cereal crops, long grass around jheels and grass meadow in the riverain area. According to Ticehurst it is less common in Upper Sind, but we found it quite common in cereal crops bordering the Pat Desert near Jacobabad.

Prinia buchanani Blyth. Rufousfronted Longtail Warbler

Quite common in desert scrub in S.W. Sind, in small groups; we have no records from elsewhere in Sind, although it may occur in grassland areas in the plains.

Prinia gracilis (Lichtenstein). Streaked Longtail Warbler

Prinia subflava (Gmelin). Plain Longtail Warbler

Both these birds are common, more especially the latter. *P. gracilis* occurs in scrubland, often near water, while *P. subflava* is more usually found in fertile cultivated areas.

Prinia flaviventris (Delessert). Yellowbellied Longtail Warbler

This delightful little warbler was first recognized in the reed beds and rushes of the Nara system above Sanghar. Since then, it was found throughout Sind, almost wherever there is suitable habitat, from Jati in the south, Kalri and Manchar lakes in the west, and Sukkur in the north. Once known, the cheerful ' tweedle-li-li ' song is unmistakable, and indicates the presence of the bird, which is otherwise often rather secretive and easy to miss. The reed beds at Habibkot were literally ringing with this song everywhere. It also occurs in long grass jungle beside jheels or canals. It can sometimes be seen singing conspicuously from the top of a reed, the ' tweedle-li-li ' note interspersed with a strong body jerk accompanied by the snapping noise that is reputed to come from the bill. There are two or three variants of the song, the usual one being a shrill, plaintive ' swee-swee-swee '.

This is the one species that would appear to have increased greatly, since Ticehurst considered it to be a very local bird, and not found everywhere where conditions were suitable.

[**Prinia criniger** Hodgson. Brown Longtail Hill Warbler

Not seen by ourselves, but it is presumably resident in the Khirtar Hills, where Roberts has seen it in January.]

Prinia burnesii (Blyth). Longtailed Grass Warbler

A fairly common bird in dense grass-tamarix jungle or other thickets in damp places. The usual call is a wheezy ' feez ', and it has a quiet nasal rattle when alarmed. When really alarmed, it has a very rapidly repeated ' chit ' or ' szik '. The song is a clear, sweet, liquid warble, of about 4 seconds, faintly reminiscent of the Dunnock (*Prunella modularis*).

Orthotomus sutorius (Pennant). Tailor Bird

Fairly common, in gardens or well-wooded areas, but also, surprisingly, in euphorbia scrub in the desert of S.W. Sind.

[**Locustella naevia** (Boddaert). Grasshopper Warbler

We have no records of this bird, which Ticehurst saw only twice in Sind.]

Acrocephalus stentoreus (Hemprich & Ehrenberg). Indian Great Reed Warbler

A fairly common winter visitor, and partial resident, especially in *phragmites* reeds. On passage, they may turn up in unlikely places ; for example on April 8, nearly a dozen were present in shrubs and a lone acacia tree in a small irrigated farm on the edge of the Pat Desert.

Acrocephalus dumetorum Blyth. Blyth's Reed Warbler

A passage migrant, fairly common in spring (early April to mid-May), but probably rare in autumn. They may halt awhile on spring passage, (one was present in a Sukkur garden from April 27 to May 14) and weak song can be heard then.

Acrocephalus agricola (Jerdon). Paddyfield Warbler

A winter visitor to margins of jheels etc., recorded in February and early March near Sukkur.

Hippolais caligata (Lichtenstein). Booted Warbler

Status uncertain, but it was not uncommon throughout the summer in riverain areas of tamarix scrub below Sukkur barrage, and is presumably resident.

Sylvia hortensis (Gmelin). Orphean Warbler

Two definite records only, in mid-March and mid-October.

Sylvia sp. Whitethroats

Without either a field-guide or specimens, the various species of whitethroat are difficult to separate in the field. *S. curruca* is abundant, visiting the more timbered areas of Sind from late-September to late-April. They sometimes arrive in quite a rush: in 1964, the first was seen in Hyderabad on September 24, but by 27 there was scarcely a bush or tree without a Lesser Whitethroat. *S. nana* was identified in the more desert regions, but records of *S. minula* and *S. althaea* were not confirmed.

Phylloscopus sp. Leaf Warblers

Leaf warblers are abundant in winter, but like *Sylvia* are also very difficult to separate in the field. The Chiffchaff (*P. collybita*) is the commonest form, and has a weak, hesitant song not unlike the European bird in its summer quarters, but involving three notes instead of two. *P. neglectus* and *P. nitidus* are the only other species recorded by Ticehurst, who comments on the absence of records in Sind of either *P. griseolus* or *P. inornatus*.

Erythropygia galactotes (Temminck). Rufous Chat

According to Ticehurst, this is an autumn passage migrant only. We did not find it until 1965, when some half-a-dozen were seen singly in scrub and dry fallow land in the desert west of Hyderabad on August 8. We were unable to visit this area again, but one turned up in a garden at Hyderabad on September 25 and 26. All these records are outside Ticehurst's extreme dates of September 3 and 24.

Erithacus svecicus (Linnaeus). Bluethroat

A passage migrant and winter visitor from late-October to late-March (perhaps early-April) to damp localities, usually seen on the ground or in low vegetation around marshes, irrigated fields etc. Weak song has been heard in late-November and in February. Males in spring in breeding plumage have all been of the red-spotted form.

[**Copsychus saularis** (Linnaeus). Magpie-Robin

This bird apparently does not yet extend into Sind, although it may well do so as a result of agricultural development. Roberts has recorded it at Bahawalnagar in Bahawalpur Division.]

Phœnicurus ochruros (S. G. Gmelin). Black Redstart

A common winter visitor from October to March (extreme dates, September 25 and March 27), from riverain forests to desert scrub. It is the commonest of the migrant chats in the better-wooded areas.

[**Saxicola macrorhyncha** (Stoliczka). Stoliczka's Bush Chat

A pair of chats believed to be of this species was seen on February 28 in the Pat Desert, but the male was not closely observed. The site was an abandoned field, with dense dry ground vegetation, in a desert area.]

Saxicola torquata (Linnaeus). Stone Chat

A winter visitor in very small numbers to damp, marginal areas of cultivation from October to February ; few records from Lower Sind. Some records may refer to the next form.

Saxicola leucura (Blyth). Whitetailed Stone Chat

One male identified in dried-up reed beds and grass-tamarix jungle at Habibkot on June 26 is our only definite record of this resident chat.

Saxicola caprata (Linnaeus). Pied Bush Chat

A common resident, widely distributed in scrub jungle and especially in damp, non-saline areas. It is less common in the most densely cultivated areas. The short song was likened to ' we are tea for two ' (highest note on ' tea '). A nest in a hole in a grassy bank was found on May 26, and immatures are seen mostly in June.

Oenanthe isabellina (Temminck). Isabelline Wheatear

A rather uncommon winter visitor. Our records are all from desert scrub in Lower Sind (mostly in the Dabeji area, east of Karachi, from mid-September to November).

Oenanthe xanthoprymna (Hemprich & Ehrenberg). Redtailed Wheatear

A winter visitor to rocky areas (or embankments etc., in the desert portions of the plains); extreme dates, October 4 and February 8 (none were seen at Ranikot in the Lakki Hills on February 14).

Oenanthe deserti (Temminck). Desert Wheatear

A common winter visitor to semi-desert areas or adjacent cultivation (and according to Roberts to coastal dunes near Karachi) from October to March. Stragglers were seen on September 12 near Tatta and April 11 in the Pat Desert.

Oenanthe picata (Blyth). Pied Chat

A very common winter visitor to cultivation, desert scrub, villages etc. Males greatly predominate over females. It arrives early (August 1 is our earliest date), and during August and September the song is heard commonly, as the birds adopt their winter territories. Most have left by early March. We have no records of the 'Whitecapped' and 'Strickland's' forms in Sind.

[**Oenanthe monacha** (Temminck). Hooded Chat

Oenanthe alboniger (Hume). Hume's Chat

We have no records of either of these chats, both inhabitants of the Khirtar Hills.]

Saxicoloides fulicata (Linnaeus). Indian Robin

A common resident. Ticehurst found it a bird of thin desert-scrub, and was surprised to find it in damp grass-scrub areas. We found it very common in the cultivated plains, often near habitation, but always in dry sites.

Monticola saxatilis (Linnaeus). Rock Thrush

A female or immature male was obtained in euphorbia scrub at Dabeji, near Karachi, on October 6, 1963.

[**Monticola solitarius** (Linnaeus). Blue Rock Thrush

We have no records of this winter visitor to the higher hill ranges.]

[**Turdus ruficollis** Pallas. Redthroated Thrush

The blackthroated form is perhaps common in some winters only. Roberts has recorded it at Kandhkot in February, but we never found it.]

Parus major Linnaeus. Grey Tit

The Grey Tit has not previously been recorded from Sind, but on March 27 and 28, 1964, a single bird was seen by D.A.H. at Usta

Mohammed, near Jacobabad. The location is in fact just outside the boundary of the former Sind province, but the habitat is more typical of the fertile Sind plains, and quite unlike the adjacent bare desert of Baluchistan. The bird was frequenting tall, canal-side shisham trees adjacent to the well-timbered garden of Usta Mohammed Inspection Bungalow. These trees would be the first that a bird would encounter after straggling down from the Baluchistan mountains across the barren Pat Desert, in the cold winter of that year. It was closely observed for a period of half-an-hour on the first day. Sub-species could not be established from a sight record, but Ziarat, the type-locality of *P.m ziaratensis*, is only 130 miles distant.

Remiz pendulinus (Linnaeus). Penduline Tit

Two Penduline Tits were seen by D.A.H. on February 15, 1963, feeding in reeds and rushes beside the Mithrao Canal near Sindri, some 50 miles north-east of Hyderabad. This species has only previously been recorded in Sind near Sukkur in February 1904, and this new record constitutes the most southerly record in Sind, if not in the sub-continent. According to Roberts, it is a not uncommon winter visitor to shisham forests near Khanewal, in Lower Punjab, where we ourselves saw it in 1965.

Some discrepancies in the head plumage compared with the European form were puzzling in 1963. In the latter form, the black stripe extending from the bill through the cheek terminates at the ear coverts, whereas in the Sind form the stripes meet at the rear of the crown, behind which there is a white or pale grey bar across the nape. However, a specimen obtained at Khanewal in 1965 confirmed that the head plumage differs from that of the European form.

Anthus sp. Pipits

The pipits were rather overlooked. The Tawny Pipit (*A. campestris*) is a common winter visitor to fallow and barren land, and open fields away from trees, and the Water Pipit (*A. spinoletta*) to wet ground. The resident Paddyfields Pipit (*A. novaeseelandiae*) is quite common in the non-saline grasslands of the riverain areas and around jheels ; a nest with 3 eggs was found in a forest clearing at Sukkur on May 25.

Motacilla flava Linnaeus. Yellow Wagtail

Winter visitor, and abundant passage migrant (earliest date, August 14). *M. f. beema* and *M. f. melanogrisea* appear to be the races involved. The latest date is April 17, apart from one *melanogrisea* seen at Habibkot, near Sukkur, on June 26.

Motacilla citreola Pallas. Yellowheaded Wagtail

Perhaps commoner than *M. flava*, but with similar status, although a greater number of this species over-winter. Extreme dates are September 5 and May 9.

Motacilla alba Linnaeus. White Wagtail

A very common winter visitor, and perhaps passage migrant, from September to April (earliest date, August 24). The main arrival is in late-September and early-October.

[**Motacilla maderaspatensis** Gmelin. Large Pied Wagtail

This wagtail was once considered to be a resident in the East Nara District, but neither Ticehurst nor we have seen it in Sind, although it is common in the Lower Punjab.]

Nectarinia asiatica (Latham). Purple Sunbird

A common resident in the south, and summer visitor in Upper Sind arriving about early March. At Hyderabad, numbers are only slightly decreased in winter. Habitat ranges from gardens and cultivation to desert scrub. The red and yellow pectoral tufts, clearly visible in birds of the Lower Punjab, are extremely difficult to see in Sind birds.

[**Zosterops palpebrosa** (Temminck). White-eye

It is strange that the White-eye, which is common in the Lower Punjab, is not found in Sind except in rare colonies in the mangrove swamps at Karachi, where Ticehurst saw them only after prolonged searches. We ourselves did not see them.]

Passer domesticus (Linnaeus). House Sparrow

Abundant, near all human habitations. In late winter, dense roosting flocks of many thousands, in reed beds and grass scrub in Upper Sind, perform high speed aerial evolutions before retiring.

[**Passer hispaniolensis** (Temminck). Spanish Sparrow

This sparrow is said to winter in Upper Sind in small numbers, but we never identified it at the sparrow roosts.]

Passer pyrrhonotus Blyth. Sind Jungle Sparrow

Not uncommon in the riverain forests and tamarix jungle around jheels, co-existing with *P. domesticus* where human habitations lie in such localities. A female was seen at the nest at the end of February at Muradani (south of Tatta), and nestlings were seen near Sukkur in early-July.

Petronia xanthocollis (Burton). Yellowthroated Sparrow

A fairly common but rather locally distributed bird, common in the riverain forests and similar sites, but ranging also to trees in desert areas.

It was the commonest ' sparrow ' at Jamraohead in May. It is resident in the South, but is said to be a summer visitor only in Upper and Central Sind, breeding in April and May.

Ploceus philippinus (Linnaeus). Baya

Probably less common than the next species, but widely distributed in the cultivated areas, colonies often nesting in acacia trees in quite open cultivated land.

[**Ploceus benghalensis** (Linnaeus). Blackthroated Weaver Bird

There are early records of this bird in Sind, but neither Ticehurst nor we have seen it, and Eates (personal communication) saw it only once, near Badin in 1922.]

Ploceus manyar (Horsfield). Streaked Weaver Bird

Very common in the cultivated areas, especially along canals, favouring canal-side patches of reeds and rushes. Locally it is abundant; there were colonies every 50 yards or so along the reedy margins of the Mithrao Canal. The males, in breeding plumage and song, first become conspicuous at the end of March or early April; nest-building commences in May.

Estrilda amandava (Linnaeus). Red Munia

Generally distributed in small parties over the cultivated areas, especially long grass and rushes in damp sites.

Lonchura malabarica (Linnaeus). Whitethroated Munia

Generally distributed in small parties over the cultivated areas, extending into desert scrub and the foothills.

[**Serinus pusillus** (Pallas). Goldfronted Finch

Recorded at Sukkur (Cole 1931) as a winter vagrant, but no subsequent records.]

[**Rhodopechys githaginea** (Lichtenstein). Trumpeter Bullfinch

This bird descends to the rocky foothills in winter, and Roberts has seen it near Karachi in April, through to May.]

[**Carpodacus erythrinus** (Pallas). Common Rosefinch

Roberts has seen this wintering in thorn scrub ravines in the Khirtar Range.]

Emberiza melanocephala Scopoli. Blackheaded Bunting

An abundant passage migrant through the cereal crops of Lower and Central Sind from mid-March to mid-April. Return passage commences in the second half of August (earliest, August 14, Sehwan). It apparently does not pass through Upper Sind. Males predominate.

[**Emberiza bruniceps** Brandt. Redheaded Bunting

This bunting was not included in Ticehurst's list. We did not find any among the spring flocks of the Blackheaded, but had unconfirmed records from Sehwan in August.]

[**Emberiza stewarti** (Blyth). Whitecapped Bunting

This bird evidently straggles into Sind only rarely, but neither Ticehurst, Roberts nor ourselves have met with it.]

Emberiza buchanani Blyth. Greynecked Bunting

We have only two records of this passage migrant, both in the spring of 1965. On April 9, a small party, composed mostly of males, was seen in euphorbia scrub on a rocky spur overlooking the Indus near Tatta, and on April 15 a male was seen in a housing compound at Sukkur.

[**Emberiza cia** Linnaeus. Rock Bunting

A winter visitor to the mountain ranges west of Sind, which Roberts has seen in the southern-most hills north of Karachi.]

Emberiza striolata (Lichtenstein). Striped Bunting

A winter visitor to rocky desert, recorded commonly around Karachi and Kot Diji. In mid-February, it was the commonest bird at Ranikot in the Lakki Hills, and in full song (likewise in the lower reaches of the Bolan Pass in mid-April), and it may breed in the Khirtar, even in the foothills.

[**Emberiza schoeniclus** (Linnaeus). Reed Bunting

Single birds recorded on three occasions by Ticehurst seem to be the only records of this bird in Sind.]

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(Concluded)

Ferns and Fern-Allies of Rajasthan

BY

P. L. MITAL

Botany Department, Government College, Ajmer (India)

Twenty genera and thirty-four species including cultivated ones of different families of ferns and fern-allies have been found in the State of Rajasthan. Out of which seventeen genera and twenty-seven species are from Mt. Abu while thirteen genera and eighteen species have so far been recorded in the plains of Rajasthan.

Eight species of six genera are recorded for the first time from the State. They are *Equisetum ramosissimum* subsp. *ramosissimum, Isoëtes* sp., *Ophioglossum petiolatum, O. reticulatum, Ceratopteris thalictroides, Athyrium parasnathense* and *A. puncticaule,* and *Cyrtomium caryotideum.*

Rajasthan situated between 23°3′ and 30°12′ N. and 69°3′ and 78°17′ E. has an area of *c.* 338,163 sq. km. It is mostly of dry sandy desert, but also has fertile plains, plateaux, forests, and hills rising as high as nearly 1200 metres (4000 ft.) above sea-level with Mt. Abu as the highest point between the Himalayas and the Nilgiris. The Aravalli Range runs from north-east to south-west almost across the entire State, dividing it into two natural regions—north-western which comprises three-fifths of the total area of the State, and south-eastern which comprises two-fifth of the total area. The north-western region is on the whole a sandy ill-watered and unproductive area ; it, however, improves gradually as one moves from west to east. While the extreme west is a desert, the eastern part is comparatively fertile. The only river of consequence in this region is the Luni. The desert forming the whole of the frontier between Rajasthan and Sind (Pakistan) is covered by sand dunes. The poor vegetation in this region depends entirely on scanty rainfall.

The region south of Aravalli is more diversified in character with more fertile soil. It contains extensive ranges, long stretches of rocky woodlands. The region is traversed by many rivers and rivulets, although they are not perennial. The important rivers are the Banas and the Chambal. There are no natural fresh-water lakes in Rajasthan, the only considerable basin being the well-known salt lake of Sambhar. There are, however, numerous artificial sheets of water in the eastern half of the State.

Rajasthan naturally supports little cryptogamic flora except perhaps some mosses and species of *Riccia* which appear in the rainy season in many shady and moist places. Among the ferns, Gupta (1954, 1955, 1962) reported the occurrence of the water fern *Marsilea* from this area including even Jaisalmer. The other water fern *Azolla*, too, is quite common in many places in Rajasthan. Besides these the Hydropterideae, *Actiniopteris radiata* and some species of *Adiantum* are also commonly met with in many places.

It is apparent from the available literature that earlier workers had confined their attention to the phaenerogamic flora from different localities of Rajasthan and for the pteridophytic flora they had only focussed their attention on Mt. Abu and no other locality in the State of Rajasthan. It was, therefore, thought worthwhile to study the ferns and fern-allies of the entire State.

A number of places like Ajmer, Alwar, Sriganganagar, Udaipur, Bharatpur besides Mt. Abu were visited more than once. While other suitable places will be explored for this study, the present account is chiefly based on the collection made from the above-mentioned localities. All species so far encountered or dealt with by earlier workers have been arranged below according to the phylogenetic scheme adopted by Mehra (1961).

FERN-ALLIES

Family EQUISETACEAE

Equisetum Linn.

Equisetum ramosissimum Desf. subsp. **ramosissimum.** Hauke, Mon. Equisetum 54, 1963. *E. ramosissimum* Desf. Fl. Atlant. 2 : 398, 1800.

Marshy places, Siliserh, Alwar, *P. L. Mital*, 4E/1, November, 1962 ; on the bank of canal, Sriganganagar, *K. Balbir Singh Dillhon*, E/2, October, 1965 ; on the bank of streams, Nasirabad Ghati, Ajmer, *P. L. Mital*, E/3, August, 1958 ; Ajaisar, Ajmer, *V. S. Sharma*, E/4, October, 1961. It is also found at Jaipur and Mt. Abu but the author did not collect.

Family ISOËTACEAE

Isoëtes Linn.

Isoëtes sp.

On way to Gomukh, Mt. Abu, *J. R. Sharma*, I/6, August-September 1960 ; near Anadra point, Mt. Abu, *J. R. Sharma* I/7, August-September 1966.

Rare, usually found growing with *Kyllinga* sp. on moist shady places. The specific description will be published separately.

FERNS

I. Ophioglossaceous series

Family Ophioglossaceae

Ophioglossum Linn.

1. **Ophioglossum reticulatum** Linn. Sp. Pl. 1518, 1753 ; Hook. & Bak. Syn. Fil. 446, 1874 ; Bedd. Handb. Ferns Brit. Ind. 465, 1892 ; Clarke in Trans. Linn. Soc. Lond. II, Bot. 1 : 586, 1880.

Moist place near Sunset Point, Mt. Abu, *P. L. Mital*, 0/8, October 1958 ; 330/9, September 1964 ; near Sunset Point, Mt. Abu, *S. K. Sharma*, 0/10, October 1959 ; Mt. Abu, *T. V. Devasia* 0/11, September-October, 1958. Common, mixed with grass along water channels under shade of Banyan tree near Sunset Point at Mt. Abu.

2. **O. petiolatum** Hook. Exotic Flora 1 : 56, 1823 ; Mehra & Bir in Res. Bull. Panjab Univ. 15 : 103, 1964. *O. pedunculosum* Prantl in Jahrb. Bot. Gart. Berlin 3 : 328 (non Desvaux, 1811). *O. pedunculatum* Nakai in Bot. Mag. Tokyo 39 : 193, 1925.

Nag-Pahar, Ajmer, *P. L. Mital*, 0/12, August-September, 1957 ; 0/13, 1958 ; 0/14, 1959 ; 0/15, 1961, 0/16, 1963 ; Antade, Ajmer, *P. L. Mital*, 0/17, August-September, 1959 ; 0/18, 1960 ; 0/19, 1961 ; 0/20, 1962.

Common, mixed with grass along water channels or moist, shady, situations. These plants are of small size and inconspicuous.

Raizada (1954) recorded *Ophioglossum* sp. from Mt. Abu but without specific identification.

Botrychium Swartz

1. **Botrychium lanuginosum** Wall. [List n. 48, 1828] ex C. Chr. Ind. Fil. 162, 1906. *Botrychium virginianum* (L.) Sw. Syn. Fil. 171 ; Clarke in Trans. Linn. Soc. Lond. II, Bot. 1 : 588 : 1880. *Osmunda virginiana* Linn. Sp. Pl. 1519. *Botrychium virginianum* Sw. var. *β. lanuginosum* Bedd. F.S.I. t. 67, 1863 & Handb. Ferns Brit. Ind. 471, t. 294. 1892.

Sutaria (1941), Raizada (1954), Bir & Verma (1961) have recorded it from Mt. Abu but the author did not collect.

IV. Schizeacheous series

Family Marsileaceae

Marsilea Linn.

1. **Marsilea aegyptiaca** Willd. Sp. Pl. 5 : 540, 1810 ; Baker, Handb. Fern-allies 145, 1887 ; Gupta in Jour. Bom. nat. Hist. Soc. 52 : 954, 1955.

Ajmer, Bhilwara, Jodhpur, Jaisalmer, Merta City, Beawar (Gupta & Bhardwaja 1957, 1958; Gupta, 1962).

2. **M. rajasthanensis** Gupta var. **ballardii** (Gupta) Gupta, Monog. 30, 1962. *M. ballardii* Gupta in Jour. Bom. nat. Hist. Soc. 53 : 289, 1955.

Udaipur, Jaipur, Kota, Ajmer, Bikaner, Kolyat, Merta City, Beawar (Gupta & Bhardwaja 1957, 1958 ; Gupta 1962).

3. **M. condensata** Baker, Bot. 281 & Handb. Fern-allies 145, 1887 ; Gupta, Monog. 28, 1962.

Nimla, Barmer (Gupta & Bhardwaja 1957, 1958 ; Gupta 1962).

4. **M. minuta** Linn. Mant. Pl. 2 : 308, 1771 ; Baker, Handb. Fern-allies 140, 1887 ; Gupta, Monog. 23, 1962.

Ajmer, Udaipur, Kota, Bharatpur, Sarwad, Dungarpur, Sriganganagar, Suratgarh, Rajkiawas, Pali, Bhilwara, Bikaner, Kolyat, Pilani, Jalore, Karauli, Beawar, Banaswara, Mt. Abu (Gupta & Bhardwaja 1957, 1958 ; Gupta 1962). On way to Sunset Point, Mt. Abu, *P. L. Mital*, M/21, August-September, 1958 ; Kodra Dam, Mt. Abu, *P. L. Mital*, 38M/22, September, 1964 ; Siliserh, Alwar, *P. L. Mital*, 5M/39, November, 1962.

Family Adiantaceae

Adiantum Linn.

1. **Adiantum capillus-veneris** Linn. Sp. Pl. 1096, 1753; Clarke in Trans. Linn. Soc. Lond. II, Bot. 1 : 453, 1880 ; Bedd. t. 4, 1863, & Handb. Ferns Brit. Ind. 84, 1892 ; Holtt. Fl. Malaya 2 : 600, 1960.

Naki Lake, Mt. Abu, *P. L. Mital*, A/40, September, 1957 ; A/41, October, 1958 ; Siliserh, Alwar, *P. L. Mital*, 7A/42, November, 1962 ; Naldeswar, Alwar, *P. L. Mital*, 2A/43, November, 1962 ; Company Garden, Alwar, *P. L. Mital*, 12A/44, November, 1962 ; Ajmer, *P. L. Mital*, A/45, October, 1963. Common on moist and shady walls and rocks. Also cultivated.

2. **A. philipense** Linn. Sp. Pl. 1094, 1753 ; C. Chr. Ind. Fil. Suppl. 3, 19, 1934 ; Holtt. Fl. Malaya 2 : 598, 1960. *Adiantum lunulatum* Burm. f. Fl. Ind. 235, 1768 ; Bedd. t.1, 1863 ; Handb. Ferns Brit. Ind. 82, 1892 ; Hook. et Bak. Syn. Fil. 144, 1874 ; Clarke in Trans. Linn. Soc. Lond. II, Bot. 1 : 452, 1880 ; Bir & Verma in Res. Bull. Panjab Univ. 14 : 192, 1963. *Pteris lunulata* Retz. Obs. Bot. 2 : 28, t. 4, 1781.

Naki Lake, Mt. Abu, *P. L. Mital*, A/46, October, 1958 ; Sunset Point, Mt. Abu, *S. K. Sharma*, 3A/47, October, 1959 ; Mt. Abu, *Gyan Prakash*, 3A/49, September, 1960 ; Pandupaul, Alwar, *P. L. Mital*, 3A/50, November, 1962 ; Sunset Point, Mt. Abu, *P. L. Mital*, 24A/151, September, 1964. Extremely abundant on shaded rocks. Rooting at apex. Also collected by Sutaria (1941), Mahabale & Kharadi (1946), Raizada (1954), Bir & Verma (1961) from Mt. Abu.

3. **A. incisum** Forsk. Fl. Aeg.-Arab. 187, 1775. *A. caudatum* Bedd. t. 2, 1863 ; Handb. Ferns Brit. Ind. 83, 1892 ; Clarke in Trans. Linn. Soc. Lond. II, Bot. 1 : 453, 1880 ; Mehra, Ferns Muss. 13, 1939 ; Bir et Verma in Res. Bull. Panjab Univ. 14 : 193, 1963.

Nagphar, Ajmer, *P. L. Mital*, A/52, September, 1957 ; A/53, 1958 ; A/54, 1962 ; Nagphar, Ajmer, *T. V. Devasia*, A/55, September, 1958 ; Antade, Ajmer, *P. L. Mital*, A/56, August-September, 1961 ; A/57, 1962. In shaded situations. Extremely common in the area. Also collected by Bir & Verma (1961) from Mt. Abu.

Family SINOPTERIDACEAE

Cheilanthes Swartz

1. **Cheilanthes albomarginata** C. B. Clarke in Trans. Linn. Soc. Lond. II, Bot. 1 : 456, t. 52, 1880 ; Bedd. Handb. Ferns Brit. Ind. 94, 1892 ; C. Chr. Ind. Fil. 171, 1906. *Aleuritopteris albomarginata* (Clarke) Panigrahi in Bull. bot. Surv. India 2 : 312, 1960.

Mt. Abu, *P. L. Mital*, Ch/58, October, 1958 ; Sunset Point, Mt. Abu *P. L. Mital*, Ch/59, September, 1964 ; Kodra Dam, Mt. Abu, *P. L. Mital*, Ch/60, September, 1964 ; Anadra Point, Mt. Abu, *P. L. Mital*, Ch/61, September, 1964 ; Naki Lake, Mt. Abu, *P. L. Mital*, 18Ch/62, September, 1964. Extremely common on almost all the rocks and along road sides. Also collected by Bir & Verma (1961) from Mt. Abu.

2. **C. farinosa** (Forsk.) Kaulf. Enum. Fil. 212, 1824; Clarke in Trans. Linn. Soc. Lond. II, bot. 1 : 457, 1880 ; Bedd. Handb. Ferns Brit. Ind. 92, 1892 ; C. Chr. Ind. Fil. 174, 1906 ; Holtt. Fl. Malaya 2 : 592, 1960. *Pteris farinosa* Forsk. Fl. Aeg.-Arab. 187, 1775. *Aleuritopteris farinosa* (Forsk.) Fée, Gen. Fil. 154, t. 12B, f. 1, 1850-52.

Near Sunset Point, Mt. Abu, *P. L. Mital*, 25Ch/63, 26 Ch/63, 28 Ch/63 20Ch/63, 31Ch/63, September 1964 ; Mt. Abu, *P. L. Mital*, Ch/64, October, 1958. On moist soil or shaded rocks. Also collected by Sutaria (1941), Mahabale & Kharadi (1946), Raizada (1954), and Bir & Verma (1961) from Mt. Abu.

3. **C. belangeri** (Bory) C. Chr. Ind. Fil. 172, 1906, & Suppl. 3 : 54, 1934 ; Holtt. Fl. Malaya 2 : 591, 1960. *Pteris belangeri* Bory, Bil. Voy. Bot. 2 : 44, 1833, *Cheilanthes varians* Hook. Sp. Fil. 2 : 89, t. 103A,

1852 ; Hook. & Bak. Syn. Fil. 136, 1874 ; Bedd. t. 189, 1863, & Handb. Ferns Brit. Ind. 91, t. 47, 1892 ; Clarke in Trans. Linn. Soc. Lond. II, Bot. 1 : 455, 1880.

This fern has recently been reported from Mt. Abu. by Kanodia & Deshpande (1962) under the old name *Cheilanthes varians* Hook. It has not been collected by the author.

Family GYMNOGRAMMACEAE

Actiniopteris Link

1. **Actiniopteris radiata** (Sw.) Link. Fil. Sp. 80, 1841 ; Bedd. t. 124, 1863 ; Hook. et Bak. Syn. Fil. 246, 1874. *A. dichotoma* Kuhn. Bot. Zeit. 504, 1871 ; Clarke in Trans. Linn. Soc. Lond. II, Bot. 1 : 505, 1880 ; Bedd. Handb. Ferns Brit. Ind. 197, t. 98, 1892. *A. australis* var. *radiata* C. Chr. in Dansk. Bot. Ark. 7 : 125, 1932.

Happy Valley, Ajmer, *Y. P. Rastogi*, A/119, August, 1950 ; Udaipur, *S. Venkatacharya*, A/120, September, 1956 ; Nagphar, Ajmer, *P. L. Mital*, A/121, October, 1957 ; Antade, Ajmer, *P. L. Mital*, A/122, September, 1958 ; Adarshnagar hillocks, Ajmer, *P. L. Mital*, A/123, September, 1958 ; Ajmer, *P. L. Mital*, A/124, 1959 ; A/125, 1960 ; Mt. Abu, *S. K. Sharma*, 10A/126, October, 1959 ; Nasirabad Ghati, Ajmer, *P. L. Mital*, A/127, August, 1963. I have seen this plant growing in exposed habitat at Jaipur, Alwar, Nim-ka-Thana, Kheteri, Beawar and Chittorgarh. Abundant in rather exposed habitat, in plains and at lower elevations under moist and humid conditions. Also collected by Raizada (1954) and Bir & Verma (1961) from Mt. Abu.

Family PARKERIACEAE

Ceratopteris Brong.

1. **Ceratopteris thalictroides** (L.) Brong. Bull. Soc. Philom. 186. c, tab., 1821 ; Clarke in Trans. Linn. Soc. Lond. II, Bot. 1 : 471, 1880 ; Bedd. Handb. Ferns Brit. Ind. 123, t. 63, 1892 ; Holtt. Fl. Malaya 2 : 567, 1960. *Acrostichum thalictroides* Linn. Sp. Pl. 1079, 1753.

Udaipur, *J. P. Agnihotri*, C/65, September-October, 1960 ; Rare. Along streams.

Family PTERIDACEAE

Pteris Linn.

1. **Pteris vittata** Linn. Sp. Pl. 1074, 1753 ; C. Chr. Ind. Fil. 2 : 59, 1917 ; Holtt. Fl. Malaya 2 : 396, 1960. *P. longifolia* auctt. Bedd. t.

33, 1863, & Handb. Ferns Brit. Ind. 106, t. 55, 1892 ; Clarke in Trans. Linn. Soc. Lond. II, Bot. 1 : 461, 1880.

Company Garden, Alwar, *P. L. Mital*, 9P/66, November, 1962 ; Ajmer, *P. L. Mital*, P/67, October, 1962. Cultivated. Also collected by Bir & Verma (1961) from Mt. Abu.

V. Hymenophyllaceous series

Family Salviniaceae

Azolla Lam.

1. **Azolla pinnata** R. Br. Prodr. 167, 1810.

Ghana, Bharatpur, *P. L. Mital*, AZ/68, February, 1963 ; Alwar, *P. L. Mital*, 6AZ/69, November, 1962 ; Ajmer, *P. L. Mital*, AZ/70, November, 1964. Extremely abundant. Also reported by Mahabale & Kharadi (1946) from Mt. Abu.

Family Oleandraceae

Nephrolepis Schott.

1. **Nephrolepis cordifolia** (Linn.) Presl. Tent. Pterid. 79, 1836 ; Clarke in Trans. Linn. Soc. Lond. II, Bot. 1 : 540, 1880 ; Bedd. Handb. Ferns Brit. Ind. 282, t. 144, 1892 ; Holtt. Fl. Malaya 2 : 379, 1960. *Polypodium cordifolium* Linn. Sp. Pl. 1089, 1753. *Nephrolepis tuberosa* Presl. Tent. Pterid. 79, 1836.

Naki Lake, Mt. Abu, *P. L. Mital*, N/71, September, 1958 ; N/72, October, 1959 ; Udaipur, *Sudhakar Mishra*, N/73, October, 1952 ; Company Garden, Alwar, *P. L. Mital*, 13N/74, November, 1962. Quite common in moist places. At Mt. Abu a few plants grew on damp wall of a well. Also cultivated. Bir & Verma (1961) also reported it from Mt. Abu.

VI. Gleicheniaceous series

Family Aspidiaceae

Cyrtomium Presl.

1. **Cyrtomium caryotideum** Presl. Tent. Pterid. 86, t. 2, f. 26, 1836 ; Bedd. t. 119, 1865. *Aspidium falcatum* Clarke in Trans. Linn. Soc. Lond. II, Bot. 1 : 512, 1880. *Cyrtomium falcatum* Sw. var. *caryotideum* Bedd. Handb. Ferns Brit. Ind. 211, t. 106, 1892.

Company Garden, Alwar, *P. L. Mital*, 11 Cy/75, November, 1962. Cultivated in very moist situations.

2. **Dryopteris cochleata** (Don.) C. Chr. Ind. Fil. 258, 1906 ; Mehra, Ferns Muss. 16, 1939. *Nephrodium cochleatum* Don, Prod. Fl. Nepal 6, 1825 ; Clarke in Trans. Linn. Soc. Lond. II, Bot. 1 : 521, 1880. *Lastrea cochleata* Moore, Index 88, 1857 ; Bedd. t. 115, 1863. *L. filix-mas* Pr. var. *cochleata* Bedd. Handb. Ferns Brit. Ind. 250, 1892. *Nephrodium filix-mas* Rich. var. *cochleatum* Don : Hook. et Bak. Syn. Fil. 272, 1872.

Sunset Point, Mt. Abu, *P. L. Mital*, D/76, September, 1958 ; 30D/77, September, 1964 ; Sunset Point, Mt. Abu, *P. L. Mital* and *S. K. Sharma*, 13D/78, October, 1959. Sterile material was collected. Not common.

Tactaria Cav.

3. **Tactaria macrodonta** (Fée) C. Chr. Ind. Fil. Suppl. 3 : 181, 1934 ; Holtt. Fl. Malaya 2 : 505, 1960. *Sagenia macrodonta* Fée, Gen. Fil. 313, t. 244, fig. 1, 1850-52. *Aspidium cicutarium* Sw. in Schrad. Jour. Bot. 1800 : 38, 1801 ; Bedd. Handb. Ferns Brit. Ind. 220, 1892. *Nephrodium cicutarium* Hook. & Bak. Syn. Fil. 299, 1874 ; Clarke in Trans. Linn. Soc. Lond. II, Bot. 1 : 539, 1880. *Sagenia coadunata* (Wall.) Bedd. t. 81, et t. 170, 1863.

Naki Lake, Mt. Abu, *P. L. Mital*, T/79, September, 1958 ; 21T/80, September, 1964 ; Sunset Point, Mt. Abu, *S. K. Sharma*, 4T/81, October, 1959 ; Sunset Point, Mt. Abu, *P. L. Mital*, T/82, September, 1958 ; Mt, Abu, *O. P. Tandon*, T/83, September, 1951 ; Mt. Abu, *Gyan Prakash*, T/84, September, 1960. Extremely common in damp and shady places. This fern was reported by Sutaria (1941) and Mahabale & Kharadi (1946) from Mt. Abu under the old name *Nephrodium cicutarium* which is a synonym of *Tactaria macrodonta*. Also collected by Raizada (1954), Bir & Verma (1961).

Hypodematium unze

4. **Hypodematium crenatum** (Forsk.) Kuhn. v. Deck. Reis. Bot. 3, 3 : 37, 1879 ; Holtt. Fl. Malaya 2 : 50 1960. *Polypodium crenatum* Forsk. Fl. Aeg.-Arab. 185, 1775. *Lastrea crenata* (Forsk.) O. Ktze. Rev. Gen. Pl. 2 : 811, 1891 ; C. Chr. Ind. Fil. 258, 1906. *Lastrea eriocarpa* Pr. Tent. 77, 1836 ; Bedd. t. 95, 1863. *Nephrodium odoratum* Bak. in Hook. et Bak. Syn. Fil. 280, 1867, 280, 1874. *N. crenatum* C. B. Clarke in Trans. Linn. Soc. Lond. II, Bot. 1 : 524, 1880.

Mt. Abu, *O. P. Tandon*, H/85, October, 1951 ; Sunset Point, Mt. Abu, *P. L. Mital*, H/86, September, 1958 ; Sunset Point, Mt. Abu, *P. L. Mital*, and *S. K. Sharma*, 8H/87, October, 1959 ; Naki Lake, Mt. Abu, *Gyan Prakash*, H/88, September, 1960. Extremely common on moist shady situations. The rhizome is dorsiventral and densely clothed with light brown paleae. Also reported by Bir & Verma (1961) and Kanodia &

Deshpande (1962) who had placed it in the old name *Lastrea crenata* which is now a synonym.

Family Athyriaceae

Athyrium Roth.

1. **Athyrium falcatum** Bedd. t. 151, 1863, & Handb. Ferns Brit. Ind. 164, t. 80, 1892 ; C. Chr. Ind. Fil. 144, 1906. *Asplenium drepanophyllum* Bak. in Hook. et Bak. Syn. Fil. 226, 1874 ; Clarke in Trans. Linn. Soc. Lond. II, Bot. 1 : 487, 1880. *Athyrium drepanophyllum* Bak. in Hook. et Bak. Syn. Fil. 226, 1874 ; Clarke in Trans. Linn. Soc. Lond. II, Bot. 1 : 487, 1880. *Athyrium drepanophyllum* Bedd. Handb. Ferns Brit. Ind. Suppl. 32, 1892.

Sunset Point, Mt. Abu, *P. L. Mital*, Ath/89 September, 1958 ; Ath/90; October, 1959 ; Sunset Point, Mt. Abu, *S. K. Sharma*, 5Ath/91, October, 1959 ; Mt. Abu, *Gyan Prakash*, Ath/92, September, 1960 ; Naldeswara, Alwar, *P. L. Mital*, 1Ath/93, November, 1962 ; Anadra Point, Mt. Abu, *P. L. Mital*, 36Ath/94, September, 1964 ; Naki Lake Mt. Abu, *P. L. Mital*, Ath/95, September, 1964. Quite common in shady places. The material collected from Alwar was sterile. Also reported by Raizada (1954) and Bir & Verma (1961) from Mt. Abu. Mahabale & Kharadi (1946) reported the genus *Athyrium* but without specific identification.

2. **A. schimperi** Moug. ex Fée, Mem. Fougères 5 (Gen. Fil.) : 187, 1850-52 ; Bedd. Handb. Ferns Brit. Ind. Suppl. 36, 1892 ; C. Chr. Ind. Fil. 146, 1906. *Asplenium filix-femina* var. *polyspora* Clarke in Trans. Linn. Soc. Lond. II, Bot. 1 : 493, 1880. *Asplenium schimperi* A. Br. in Schweinf. Beitr. 1 : 224, 1867 ; Hope in Jour. Bomb. nat. Hist. Soc. 14 : 252-53, 1902.

Sunset Point, Mt. Abu, *P. L. Mital*, Ath/96, September, 1958 ; Water supply tank, Mt. Abu, *P. L. Mital*, Ath/97, September, 1960. Common in damp and shady places. Also collected by Bir & Verma (1961) from Mt. Abu.

3. **A. parasnathense** (Clarke) R. C. Ching ex Bir in Jour. Ind. bot. Soc. 43 : 569, 1964. *Asplenium filix-femina* Bernh. var. *parasnathensis* Clarke in Trans. Linn. Soc. Lond. II, Bot. 1 : 493, t. 61, fig. 2, 1880. *Athyrium filix-femina* var. *parasnathensis* (Clarke) Bedd. Handb. Ferns Brit. Ind. 170, 1892.

Sunset Point, Mt. Abu, *P. L. Mital*, Ath/98, September, 1958 ; Mt. Abu, *Gyan Prakash*, Ath/99, September, 1960 ; Naki Lake, Mt. Abu, *P. L. Mital*, 20Ath/100, September, 1964. Common in moist shady places.

4. **A. pectinatum** Presl. Tent. Pterid. 98, 1836 ; Bedd. Handb. Ferns Brit. Ind. Suppl. 36, 1892. *Asplenium pectinatum* Wall. ex Hope in Jour. Bomb. nat. Hist. Soc. 14 : 253, 1902. *Asplenium filix-femina* Bernh. var. *pectinata* Clarke in Trans. Linn. Soc. Lond. II, Bot. 1 : 492, t. 58, 1880. *Athyrium filix-femina* Roth. var. *pectinata* Bedd. Handb. Ferns Brit. Ind. 169, 1892.

Sunset Point, Mt. Abu, *P. L. Mital*, Ath/101, September, 1958 ; Naki Lake, Mt. Abu, *S. K. Sharma*, 2Ath/102, October, 1959 ; Naki Lake, Mt. Abu, *P. L. Mital*, 19Ath/103, September, 1964. Abundant in damp places and also in moist rock crevices. The shape of the frond is variable, from linear-lanceolate to deltoid-lanceolate. Also reported by Bir & Verma (1961) from Mt. Abu. Raizada (1954) reported it under the name *Athyrium filix-femina* from Mt. Abu.

5. **A. puncticaule** (Bl.) Moore, Ind. Fil. 186, 1880 ; Alston et Bonner in Candollea 15 : 213, 1956 ; Bir in Jour. Ind. bot. Soc. 43 : 569, 1964. *Aspidium puncticaule* Bl. Enum. Pl. Jav. 2 : 162, 1828. *Asplenium macrocarpum* Bl. in J. Smith, Cat. Cult. Ferns 47, 1857 ; Clarke in Trans. Linn. Soc. Lond. II, Bot. 1 : 488, 1880 ; Hope in Jour. Bomb. nat. Hist. Soc. 14: 118, 1902. *Athyrium macrocarpum* (Bl.) Bedd. 51, t. 153, 1863, & Handb. Ferns Brit. Ind. 165, 1892 ; C. Chr. Ind. Fil. 143, 1906 ; Holtt. Fl. Malaya 2 : 550, 1960.

Sunset Point, Mt. Abu, *P. L. Mital*, Ath/104, September, 1958 ; Water Supply Tank, Mt. Abu, *Gyan Prakash*, Ath/105, September, 1960 ; Gomukh, Mt. Abu, *P. L. Mital*, 37Ath/106, September, 1964. Quite common in moist shady situations and in crevices of rocks.

6. **A. hohenackerianum** (Kze.) Moore, Index 39, 1857 ; Bedd. t. 150, 1863, & Handb. Ferns Brit. Ind. 163, 1892. *Asplenium hohenackerianum* Kunze, Bot. 771, 1849. This fern has been reported by Kanodia & Deshpande (1962) from Mt. Abu, but not collected by the author.

Diplazium Swartz

7. **Diplazium esculentum** (Retz.) Sw. in Schrad. Jour. Bot. 1801, 312, 1803; Mehra & Bir in Res. Bull. Punjab Univ. 15 : 148, 1964. *Hemionitis esculenta* Retz. Obs. 6 : 38, 1791. *Digrammaria esculenta* Retz. Obs. 6 : 38, 1791. *Hemionitis esculenta* (Retz.) Fée, Gen. 217, 1850-52. *Asplenium esculentum* (Retz.) Presl. Rel. Haenk. 1 : 45, 1825 ; Hook. & Bak. Syn. Fil. 244, 1874 ; Clarke in Trans. Linn. Soc. Lond. II, 1 : 503, 1880 ; Hope in Jour. Bomb. nat. Hist. Soc. 14 : 245, 1902. *Anisogonium esculentum* Presl, Tent. Pterid. 116, 1836 ; Bedd. Handb. Ferns Brit. Ind. 192, t. 94, 1892.

Company Garden, Alwar, *P. L. Mital*, D/107, November, 1962; Ajmer, *P. L. Mital*, 10D/107, November, 1962. Cultivated.

Kanodia & Deshpande (1962) reported *Diplazium sylvaticum* from Mt. Abu, but not seen by me.

Family THELYPTERIDACEAE

Cyclosorus Link

1. **Cyclosorus dentatus** (Forsk.) Ching in Bull. Mem. Inst. Biol. Bot. Ser. 8(4) : 206, 1938. *Polypodium dentatum* Forsk. Fl. Aeg.-Arab. 185, 1775. *Nephrodium molle* Bedd. Handb. Ferns Brit. Ind. 277, 1892.

Sunset Point, Mt. Abu, *P. L. Mital*, Cy/108, September, 1957 ; Sunset Point, Mt. Abu, *S. K. Sharma*, 12Cy/109, October, 1959 ; Company Garden, Alwar, *P. L. Mital*, 8Cy/110, November, 1962. Common in moist and shady places. Also cultivated. Also collected by Bir & Verma (1961).

Asplenium Linn.

1. **Asplenium pumilum** Sw. var. **hymenophylloides** Fée, 7th Mém. 54, t. 15 fig. 1, 1857 ; Clarke in Trans. Linn. Soc. Lond. II, Bot. 1 : 482, 1880 ; Bedd. Handb. Ferns Brit. Ind. 154, 1892.

Sunset Point, Mt. Abu, *P. L. Mital*, A/113, September, 1957 ; A/114, September, 1958 ; 3A/115, September, 1964 ; Naki Lake, Mt. Abu, *P. L. Mital*, A/111, September, 1957 ; A/112, September, 1958 ; Sunset Point, Mt. Abu, *S. K. Sharma*, 6A/116, October, 1959 ; Naki Lake, Mt. Abu, *S. K. Sharma*, 6A/117, October, 1959 ; Mt. Abu, *Gyan Prakash*, A/118, September, 1960. Extremely common on moist shady rocks. It is very small in size (ranges few cm.) and is conspicuously covered all over with uniseriate multicellular hairs. Also reported by Mahabale & Kharadi (1946) and Bir & Verma (1961) from Mt. Abu.

2. **A. lunulatum** Sw. in Schrad. Jour. Bot. 1800, 52, 1801 ; Hook. et Bak. Syn. Fil. 202, 1874 ; Bedd. Handb. Ferns Brit. Ind. 147, 1892 ; C. Chr. Ind. Fil. 119, 1906 ; & Suppl. 2 : 35, 1934.

It has been reported by Kanodia & Deshpande (1962) from Mt. Abu, but the author did not collect.

ACKNOWLEDGEMENTS

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A new subgenus of *Xenosiphon* (Sipunculidae) and description of a new Species from Indian waters

BY

PEACE JOHNSON

Department of Zoology, Christ College, Irinjalakuda

(*With a plate*)

INTRODUCTION

The genus *Xenosiphon* was created by Fisher in 1947 to include the peculiar sipunculid *Sipunculus mundanus* var. *branchiatus* Fischer, 1895, having a pair of protractor muscles in addition to the four retractor muscles. Later two more species, *X. mundanus* (Selenka, deMan & Bulow) and *X. caribqeum* Fisher were reported. Considering the nature of the coelomic canals in the trunk wall, Fisher (1954) created two subgenera namely *Xenosiphon* to include *X. branchiatus* and *X. caribaeum* and *Austrosiphon* to include *X. mundanus*. The specimens collected from Minicoy, Laccadives have been examined by me and they differ from these three species so greatly that it justifies separation as a new species of a distinct subgenus. In this paper I have redescribed the generic characters of *Xenosiphon* including the subgenera and the species *X. indicus* sp. nov. has been fully described. This is the first report on species of the genus *Xenosiphon* from Indian seas.

Genus *XENOSIPHON* Fisher

Xenosiphon Fisher, 1947, p. 360 ; 1952, p. 377.

Diagnosis :

Very large forms with thick body wall. Trunk surface smooth, produced into rectangular areas. Introvert provided with scaly or triangular-shaped, backwardly directed papillae. Hooks and spines absent on the introvert. Tentacles foliaceous. A pair of muscles functioning as protractors. Retractors four or two. Rectum usually long and anus anterior to nephridiopores. Spindle muscle arises from rectal wall. Accessary intestinal loop sometimes present. Cephalic tube may be wanting. Subcutaneous coelomic system either as independent irregular sacs or as longitudinal canals.

Subgenus *Xenosiphon* Fisher

Diagnosis :

Retractors four. Protractors two. Subcutaneous coelomic system as independent irregular sacs. No accessary intestinal loop.

Type species: *X. branchiatus* (Fischer)

Subgenus *Austrosiphon* Fisher

Diagnosis :

Retractors four. Protractors two. Subcutaneous coelomic system as longitudinal canals. Simplified intestinal loop.

Type species : *X. mundanus* (Selenka, deMan & Bulow).

Subgenus **Xenopsis** subgen. nov.

Diagnosis :

Retractors two. Protractors two. Subcutaneous coelomic system as longitudinal canals. Accessary intestinal loop present. No cephalic tube.

Type species : *X. indicus* sp. nov.

Xenosiphon indicus sp. nov.

Material : Two specimens collected by Sri V. M. N. Namboodiripad of Malabar Christian College, Kerala, from Minicoy Island, Laccadives, in December 1962.

The specimens are large. The larger of them measures 460 mm. in length and 10 mm. across the broadest part of the body. The introvert is short being 25 mm. long. The smaller specimen is 380 mm. long and 9 mm. broad with an introvert measuring 20 mm. in length. They are pinkish in colour. In one the introvert is well extended out while in the other it is fully withdrawn.

The skin is thick, smooth and devoid of papillae. The surface of the skin is produced into rectangular areas by circular and longitudinal grooves. The circular grooves are deeper than the longitudinal ones ; so that the smaller sides of the rectangles lie in the antero-posterior axis. The posterior end of the trunk is produced into a bulbular swelling. The introvert is short when compared to the trunk (Fig. 1). It carries numerous scale-like papillae which are directed posteriorly. These are more like tubercles than triangular. At the tip of the introvert there is the tentacular crown which surrounds the mouth. It consists of 6 sets of tentacular lappets of a thin membraneous nature. They are arranged in double rows and they are not continuous with one another (Fig. 7). The free margin of these lappets are cut into minute and coarse tentacles. Between the two rows of tentacular lappets there is a groove and all such grooves are directed towards the mouth opening. The crown gives a bushy appearance to the tip of the introvert (Fig. 1). Behind these tentacular processes a small area of the introvert is smooth without papillae. Hooks and spines are absent on the introvert. A small opening which leads to the brain, a characteristic feature of the genus *Sipunculus*, is wanting in these specimens.

Internally there are two retractor muscles which are dorsal in their attachment around the oesophagus. This pair extend downwards about one-sixth of the body length and each spans the 16th longitudinal muscle band of the body wall. These obviously function as retractors (Fig. 3). Each one is very thick anteriorly and thins out posteriorly to merge with the single 16th longitudinal muscle band of the body wall. There is a ventral pair which is attached exactly at the base of the introvert, very close and on either side of the nerve cord (Fig. 2). In the specimen where the introvert is withdrawn, these two ventral muscles are directed anteriorly while the other pair (retractors) lie directed posteriorly (Fig. 5). Obviously the ventral pair functions as protractor muscles because of their position of attachment to the body wall as well as their disposition in the withdrawn condition of the introvert. Thus there are two retractors which are dorsal and two protractors which are ventral in position. There are two long nephridia. A major part of each nephridium is attached to the body wall by mesenteries, a small part posteriorly being free. The longitudinal muscle layer is separated into 45 bands anteriorly and 40 posteriorly indicating the union of bands in the middle region. The oesophagus is very long and before entering into the main intestinal coils, makes a separate loop of itself (Fig. 4). The rectum is long and possesses a coecum. Spindle muscle arises near the anus and runs down through the centre of the intestinal coils and is not attached posteriorly. Two pollian sacs (dorsal and ventral) are present which are simple, without villi. Brain is dorsal and is placed far below the tentacular crown. It carries a frilled 'frons' at its anterior part (Fig. 6). The circumenteric connectives join ventrally to form the nerve cord. The cord is free in the introvert coelom. In the trunk it is closely apposed to the body wall being interposed by longitudinal muscle bands. In the introvert free muscle strands originate from the body wall, from either side of the nerve cord as well as from the anterior margin of the trunk wall, which fuse together to form stout muscle bands. These bands lie one on either side of the nerve cord. These are known as the paraneural muscles (Fig. 3).

Holotype and paratype: Deposited in the Zoological Museum, B. I. T. S., Pilani, Rajasthan.

Type locality: Minicoy Island, Laccadives.

Systematic position :

Xenosiphon indicus sp. nov. closely resembles the species of the genus *Sipunculus* in the following characters:

1. The skin surface is produced into rectangular areas.
2. The introvert is provided with scale-like papillæ.
3. The œsophagus makes a characteristic loop before entering into the main intestinal coils.

It differs from *Sipunculus* species in having two protractor muscles and in the absence of a cephalic tube.

The presence of protractor muscles is reported only in the genus *Xenosiphon* Fisher, 1947. Only three species, *X. mundanus* (Selenka, deMan & Bulow), *X. branchiatus* (Fischer) and *X. caribaeum* Fisher are reported so far. *X. indicus* sp. nov. differs from these three species in the following characters:

1. Only two retractor muscles.
2. Longitudinal muscle bands vary from 40-45.
3. Absence of a cephalic tube.
4. Arrangement of the tentacular crown.

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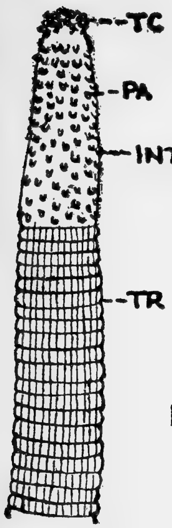

FIG-1

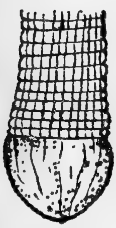

FIG.2

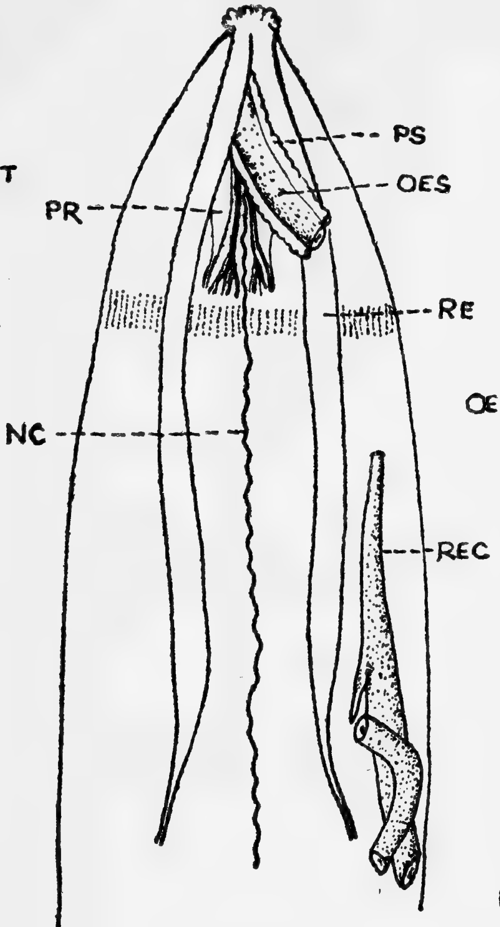

FIG.3

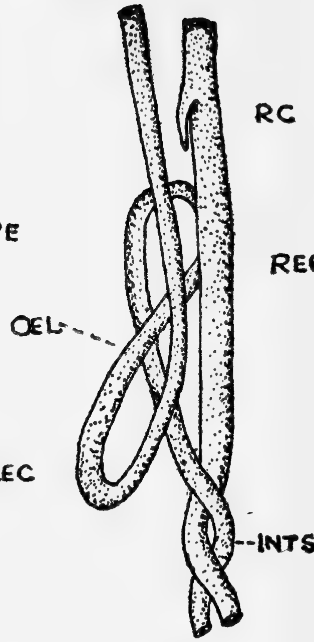

FIG.4

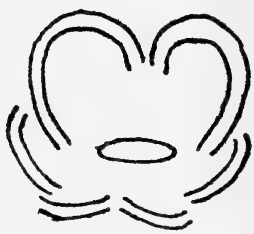

FIG.7

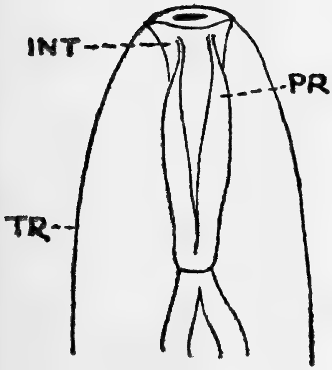

FIG.5.

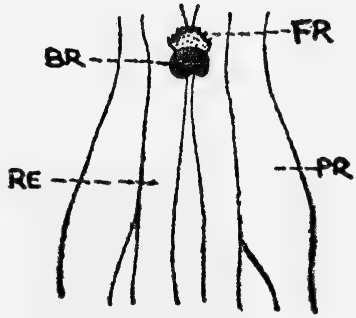

FIG.6

Xenosiphon indicus sp. nov.

(for captions, see overleaf)

1. Anterior region ; 2. Posterior region ; 3. Dissected anterior region ; 4. A part of alimentary canal showing oesophageal loop ; 5. Withdrawn introvert showing the disposition of protractors ; 6. Brain with frons ; 7. Diagrammatic design of tentacular crown.

ABBREVIATIONS

BR : Brain ; FR : Frons ; INT : Introvert ; INTS : Intestine ; NC : Nerve cord ; OEL : Oesophageal loop ; OES : Oesophagus ; PA : Papillæ ; PS : Pollian sac ; PR : Protractor muscle ; RE : Retractor muscle; REC : Rectum; RC : Rectal coecum; TC : Tentacular crown ; TR : Trunk.

A field study on the behaviour of two roadside groups of Rhesus Macaque [*Macaca mulatta* (Zimmermann)] in northern Uttar Pradesh

BY

R. P. MUKHERJEE
Zoological Survey of India, Calcutta

(*With two text-figures*)

This paper presents information about the group size, group composition, range, feeding and drinking habits, grooming, play, chase, threat and contact, sexual behaviour, attitude towards infants, behaviour of a peripheral male and formation of a sub-group of two roadside groups of rhesus macaques.

INTRODUCTION

In 1964 and 1965 the author conducted surveys, along with a team of the Johns Hopkins University under the leadership of Dr. C. H. Southwick, of northern Uttar Pradesh, Delhi, and parts of the Punjab, to study the abundance, group composition and group size of the Rhesus Macaques. In addition certain forest areas in the Kumaon region were also investigated. This paper presents the result of studies conducted by the author on two roadside groups of Rhesus Macaques near Bareilly in northern Uttar Pradesh, based on observations made during the field studies.

During the survey of 1964 two large groups of the macaques were observed at the side of the main road near two villages located very close to each other at Bareilly, U.P. Though found near villages, their main habitat was the roadside and they were classified as roadside groups. For convenience the two groups are named after two villages. In the year 1965 an attempt was made to collect as much data as possible on the behaviour of these two groups. The information based on the observations made from April to June, 1965, is incorporated in this paper.

The two villages, Karghena and Kareilly are about half a kilometre apart, situated on the Bareilly-Mathura main road, about nine kilometres south of Bareilly. The first group was near Karghena Village and the second about 0·2 kilometre south of the first group and near the second village. The trees on the two sides of the road were mostly mango (*Mangifera indica*), ' pakar ' (*Ficus wightiana*) and ' neem ' (*Azadirachta indica*). The trees were nearer to the Kareilly group than the Karghena group.

Group size and group composition

The group size of macaques near Karghena Village as counted in December, 1964, was 33 and the group size near Kareilly Village was 30. The two groups when counted in the months of April to June, 1965, showed a total of 36 monkeys each. The details of the group composition and group size of the two groups are given in Table 1. In 1965

Table 1

Group composition

Years	Kareilly					Karghena				
	Adult males	Adult females	Juveniles	Infants	Total	Adult males	Adult females	Juveniles	Infants	Total
1964 ..	6	6	12	6	30	4	7	15	7	33
1965 ..	6	8	15	7	36	4	8	17	7	36

out of the 7 infants of the Karghena group 3 were newly born and there was a peripheral male in this group. Similarly out of the 7 infants of the Kareilly group 6 were newly born. During the second survey both groups were equal in numbers and had also increased in number. However, the increase in the second group was more than in the first. In these two groups the juveniles were more in numbers, although in other groups observed during the survey, it was noticed that numbers of juveniles were less. This indicates that these two groups had escaped trapping and molestation.

During the second survey most of the females carried new born infants. One pregnant female of the Kareilly group carried a deep wound on her left thigh and she died after a few days.

Range

The groups retired for the night just before darkness sets in. The members of the Karghena group selected a big pakar tree (*Ficus wightiana*), or the roof of a permanent store house located just below this tree, for roosting. During the day also members of the troop rested, slept or groomed at these places. During the day each group moved, fed and rested as a unit. They remained close to each other most of the time. Almost all the members of both groups came down from the place of their resting near or on the road in the early morning. Their daily stereotyped movements were mainly influenced by the location of the food. Chance (1956), while working on a captive group, also observed that the movements of the animals in his group were to some extent dependent on the availability of the food. During movement sufficient numbers of animals moved together as a unit. Such type of movement was also reported by Southwick (1962) in his temple groups. Animals of the Karghena group rarely moved to the eastern side into the villages in search of food. But they very often visited the fields in the eastern and western sides in search of food. The Karghena group made frequent trips for mangoes into a mango orchard located on the north-western side, but usually they were soon chased out by villagers. Members of both groups never moved deep into the villages or the fields. The Karghena group did not move much down to the southern side and the Kareilly group to the northern side of their normal habitat. Thus the two groups tried to avoid each other (Fig. 2). This was also observed by Southwick (1962) in temple groups, although he found extensive overlapping of home ranges in the temple groups. At times the peripheral male of the Karghena group moved about half a kilometre away to the north of the main group and near to another village—Nekpur. Usually the movements of both groups were restricted to their normal habitat.

Members of both groups were very active during the morning and evening hours and the maximum movements were observed during these periods. They either moved along the main road or on the sides and often made trips into the fields or jumped from tree to tree. With the rise of day temperature their activities slowed down and between 10 a.m. and 5 p.m., they were mostly observed resting, sleeping or grooming under the shade or on the low, thick branches of trees. Bernstein & Mason (1963) also noticed that the resting increased with the increase in temperature. They have reported that the animals in their captive colony spent more time at greater height with the rise in temperature.

The members of the Kareilly group rested, groomed, or slept on different trees lining the sides of the road (Fig. 1). While most members of the first group shared a single tree, the members of the second group used more than one tree for their resting, sleeping and grooming.

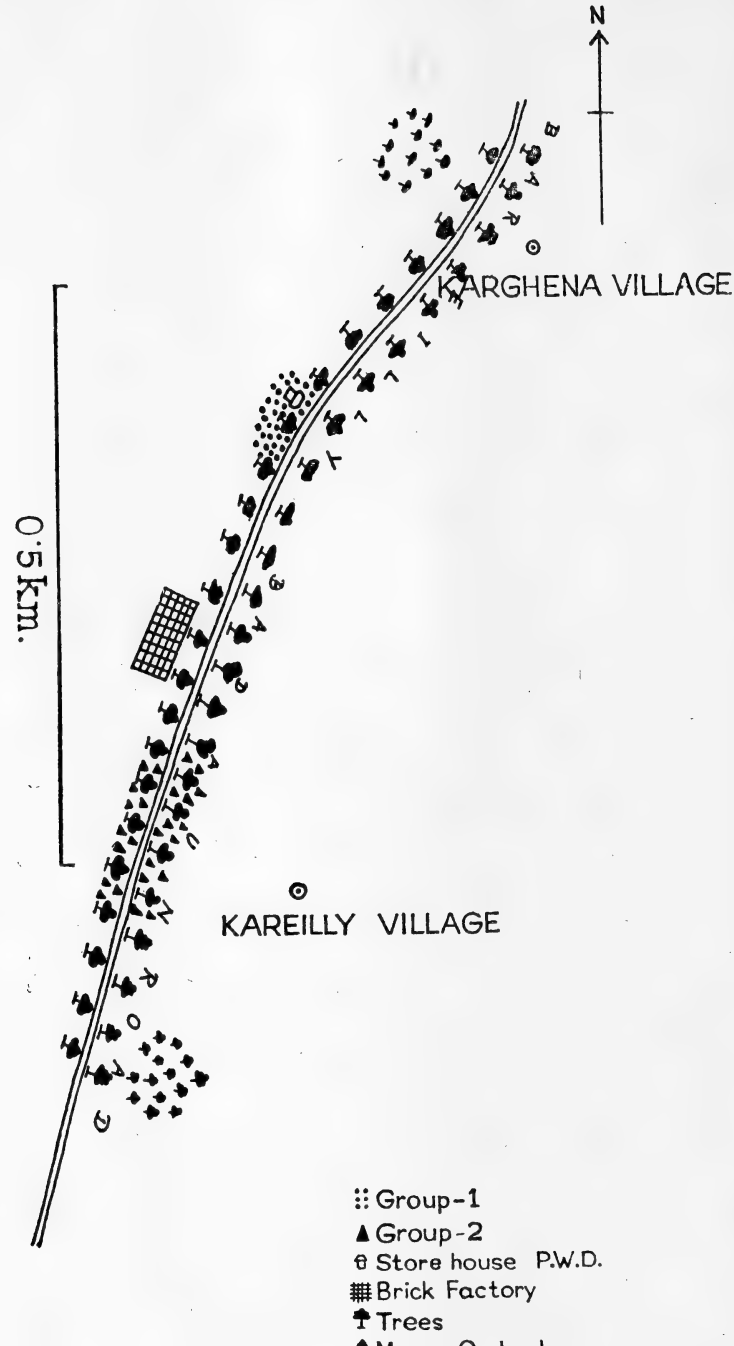

Fig. 1. Typical night-time lodging and retiring positions after morning activities of the two groups of rhesus macaques.

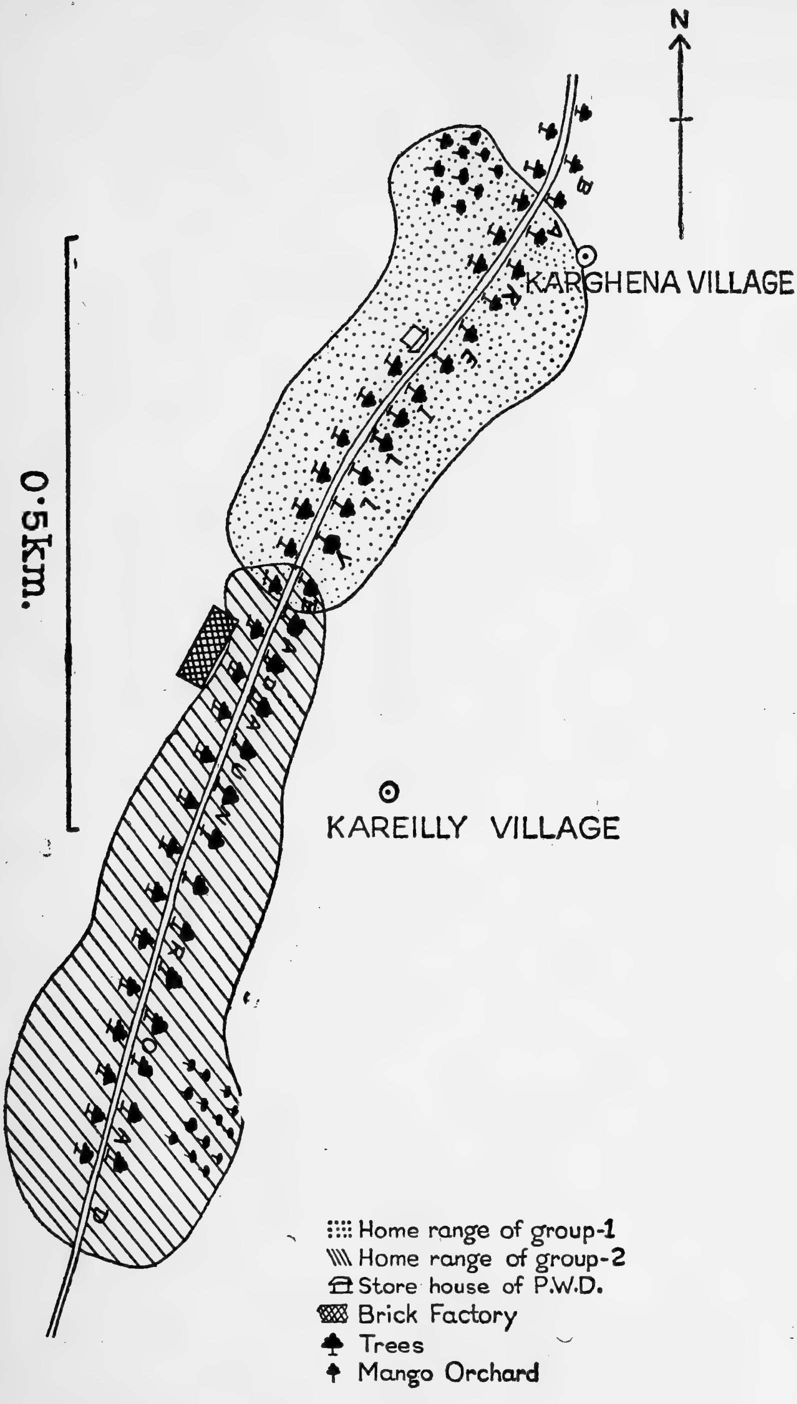

Fig. 2. Home range of two groups of rhesus macaques.

Habits and behaviour

Feeding and drinking : The main food consisted of tender leaves of mango, pakar and neem trees, mango fruits, grass or food grains left over in the village fields, scattered from loaded trucks or passing bullock carts. They preferred mango and pakar leaves more than the neem leaves. Insects also formed a part of their food. They were occasionally fed by passing villagers with grains, peanuts and fruits.

One adult male, an adult female and a juvenile of the Karghena group and an adult female of the Kareilly group very often rubbed the food with their two hands before putting it into the mouth.

A juvenile of the Kareilly group often carried food, holding it in the left foot, and on such occasions appeared as a lame animal.

The members of the two groups drank the stagnant water in the road-side ditches, usually visiting the ditches in groups, after an active morning and twice or thrice during the day and finally before retiring.

Grooming : Grooming was very common when the animals were at rest ; usually one animal was groomed by the other and often in groups of three to four. The adult females with new born infants remained close to each other while resting, sleeping or grooming.

Playing : Play was common among juveniles as they were the most active members in a group. Juveniles usually played when the adults were either resting or grooming. The juveniles played among themselves but were also noticed to play with a stick, a piece of paper, a piece of rope or a piece of cloth. Whenever their play became rough it ended in a short chase or a threat. Juveniles were also very fond of playing with infants and these were also observed playing among themselves. The infants at times also played with their mother's tail. During the period of observation, only on one occasion a dominant male was noticed to play with a juvenile.

Chase, threat and contact : Most of the agonistic behaviour was seen during feeding time and those involved were mostly adult females and juveniles. The adult males took less interest in such activities. Bernstein & Mason (1963) also reported the increase in the incidence of aggressive activities in their group during feeding time. Chance (1956), however, observed that adult males were also involved in threat, chase and contact.

When juveniles occasionally played roughly with infants and these began to cry, the mothers at once rushed to help and chased off the juveniles. At times adult males, particularly the dominant males, also rushed to help the infants and chased off the juveniles. The chase by one member could be for a short or long distance.

Adult females with infants gave more threats, chased and fought than the unaccompanied females. Whenever there was a hot chase among the members of a group, the dominant male intervened and settled the issue by chasing away the fighting members. In a hot chase or in a severe bite the defending animal was found usually either to urinate or to defecate due to fear.

No member of the two groups showed any agonistic behaviour towards infants ; rather the latter were treated with much care and affection by other members of the group. Sometimes during fights an animal slapped or pulled the body hairs of the other.

In case of a chase by villagers or by village dogs all the animals at once climbed up the nearest tree and the adult males in such circumstances defended the colony by giving threats to the attacking villagers or village dogs. In such cases the adult females with infants hurriedly collected their infants before climbing the trees, such females at times also joined the males in defending the group. Sometimes when the source of trouble was invisible, or at a considerable distance, the animals stood upon their legs to locate the source.

A fight between members of the two groups was never observed and both groups tried to avoid each other. However, villagers reported that at times the two groups engaged in severe fighting. Intergroup fights were very common in temple groups as reported by Southwick (1962). The agonistic behaviour of the two groups for a period of 35 hours is presented in Table 2.

TABLE 2

AGONISTIC BEHAVIOUR OF RHESUS MACAQUES DURING 35 HOURS OF OBSERVATION

	Total No. of threats	Total No. of chases	Total No. of Aggressive contacts
Dominant males with other males	—	5	—
Adult males with Adult females	18	21	5
Adult males with Juveniles	38	25	6
Adult females within themselves	25	16	6
Adult females with Adult males except dominant males	6	8	1
Adult females with Juveniles	91	58	7
Adult females with Infants	1	—	—
Juveniles with Adult males except dominant males	2	—	—
Juveniles with Adult females	6	1	1
Juveniles among themselves	53	31	15

From the Table it is apparent that adult males and females directed their maximum threats to juveniles and the juveniles also gave maximum threats to other juveniles. Similarly the chasing by the adult males, females and juveniles were directed towards the juveniles and the maximum contacts were recorded among the juveniles themselves. Adult males next to juveniles directed their threats, chase and contacts to adult females. Similarly the adult females next to juveniles directed their agonistic behaviour towards other females.

Sexual behaviour: Not much was observed about the sexual behaviour of the groups. None of them was breeding at that time. Some of the adult females were carrying infants, and some others were apparently in an advanced stage of pregnancy.

Behaviour of the members of a group towards infants: As mentioned earlier the infants were treated with much care and affection by all members of the two groups studied. The behaviour of the dominant males towards the infants was interesting. The dominant male allowed infants to climb on his hands, legs, back or head when he was resting. The infants approached the dominant male without any fear. In such cases the mothers of the infants usually approached the male and collected the infants from him, or after spending some time with the male they came back to their mothers. Once it was observed that an infant of the Kareilly group while playing with a juvenile cried for help and as the dominant male was feeding very close to this infant, he at once responded and rushed to the help of the infant. He chased out the juvenile and picked up and held the infant against his chest like the mother and carried the infant in this position to some distance and began to eat again. The infant after some time climbed on the back of the dominant male and remained there till the mother came and collected it. On a number of occasions it was also observed that the dominant male held the infants against his chest till either the infants themselves ran away or the mothers collected them from the male. Once an infant of the Kareilly group suddenly climbed on the back of a moving dominant male and the male carried the infant to some distance then stopped and gently tried to push off the infant from his back. Finally the infant jumped off and ran to its mother. It is, therefore, clear that the dominant males also take interest in infants.

The behaviour of a young female of the Kareilly group towards infants was also very interesting. The female was so fond of infants that whenever she got a chance she grabbed and picked up one. This was only possible when the mother was away from the infant, busy feeding, grooming or resting. In such cases she picked up the infant and held her against her chest or started to play or allowed the infant to sit on her back. She behaved like a normal mother. The mother usually rushed for the infant and the young female in such cases either left the infant and ran away or she dragged it for some distance before finally leaving it. At times the dominant male also directed threats or chased the young female when the infant cried. This female was so much attached to infants that when other members of the group were busy in other activities this female was usually with an infant. It is possible that she had lost her own infant.

One female of the Kareilly group also carried a dead infant for a number of days, even after putrification had started and finally when she left it nothing was left except the dried body.

Behaviour of the peripheral male : It was the usual habit of the peripheral male of the Karghena group to rush into the group and occupy the main tree whenever the dominant male was away from the main group. The peripheral male on entering the main group threatened other members of the group, particularly the adult females. On such occasions all the adult females, particularly the females with infants, and other males hurriedly climbed up the main tree and all the females on such occasions tried to remain as close as possible to each other and other males. Ultimately all the females and other males joined and chased out this male from the main tree to the road below and in such chases the females with infants took active part. The peripheral male after coming down from the tree always remained close to the main tree and tried to climb up and to regain its lost position. However, he was always on the look-out for the dominant male and retreated on seeing it. At times he was also chased out by the dominant male. Whenever he had the opportunity he moved into the territory of the main group, and occupied a position on the main tree, but soon retreated on finding the group returning with the dominant male.

At feeding time this male fed close to the main group and it slept, rested and moved at a certain distance from the main group. Whenever there was danger to the group this male also took part with the other members in defending the group.

Formation of a sub-group of the Kareilly group : One adult male was observed about half a kilometre away to the south of the Kareilly group, and usually resting on, or moving near, a big pakar tree. Two to three females of the Kareilly group at times joined this male and before returning to the main group they spent some time with this male. Probably it was the beginning of the formation of a sub-group of Kareilly group.

Acknowledgements

I am grateful to the Director, Zoological Survey of India, for providing facilities. Thanks are also due to Dr. C. H. Southwick of the Johns Hopkins University for co-operation and suggestions from time to time, and to Drs. B. Biswas and K. K. Tiwari of Zoological Survey of India, for going through the manuscript and valuable suggestions.

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Neoaiptasia commensali, gen. et. sp. nov.: an actiniarian commensal of hermit crabs

BY

ARUN PARULEKAR [1]

Senior Research Fellow (C.S.I.R.), Bombay Natural History Society, Bombay-1

(*With three text-figures*)

While describing the intertidal sea anemones of Bombay (Parulekar 1968), a few specimens, found attached to gastropod shells, inhabited by hermit crabs, were provisionally assigned to *Aiptasia* sp. However, a detailed examination of a number of specimens and a study of literature, shows that the species is of a genus, so far unknown. The new genus and species are described in the following pages.

Neoaiptasia gen. nov.

Diagnosis: Aiptasiidae with broad, adherent basal disc. Column smooth, undifferentiated and without cinclides. Tentaculate margin. Sphincter mesogloeal, fairly well developed. Tentacles slender, always smooth without any projections or protuberances. Mesenteries not differentiated into macro- and microcnemes ; first two cycles (12 pairs) perfect and sterile. Same number of mesenteries proximally as well as distally. Acontia with basitrichs and microbasic p-mastigophores. Cnidom: spirocysts, microbasic p-mastigophores, microbasic b-mastigophores and basitrichs.

Type Species: *Neoaiptasia commensali*

Neoaiptasia commensali sp. nov.

Material: Holotype collected from Chaupatty, Bombay (19°58′N., 72°53′E.) India, on 17th September 1967, in littoral zone. Paratypes : five in number, collected from Chaupatty, Bombay and also from Padamgad, Malvan (16°03′N., 73°28′E.) in Ratnagiri District of Maharashtra State, India. Both the holotype and the paratypes will be deposited in the collections of Zoological Survey of India, Calcutta.

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[1] Present address : National Institute of Oceanography, Miramar, Panaji, Goa.

Description

General Features: This medium-sized acontiarian is characteristic of sandy shores. It is almost always found attached to gastropod shells, either singly or in groups of 2-4 (Fig. 1). The shells (*Babylonia spirata, Thais carinifera, Turritella duplicata, Surcula javana* and rarely *Tibia curta*) are inhabited by hermit crabs, usually *Diogenes custus* or sometimes *Clibanarius padavensis*. A few anemones were also found attached to pelecypod shell of *Placenta placenta*. Occasionally, the aberrant gastropod, *Ergoea walshii*, is present on the outer lip of the gastropod shell, and rarely the polynoid *Gattayana deludens*, also inhabits the apical whorls of the shell. The colour of the actiniarian exactly matches that of the shell, so that when the anemone is in contraction, it becomes completely flat, with slight elevation near the oral region. The species is quite common during the monsoon (June-September).

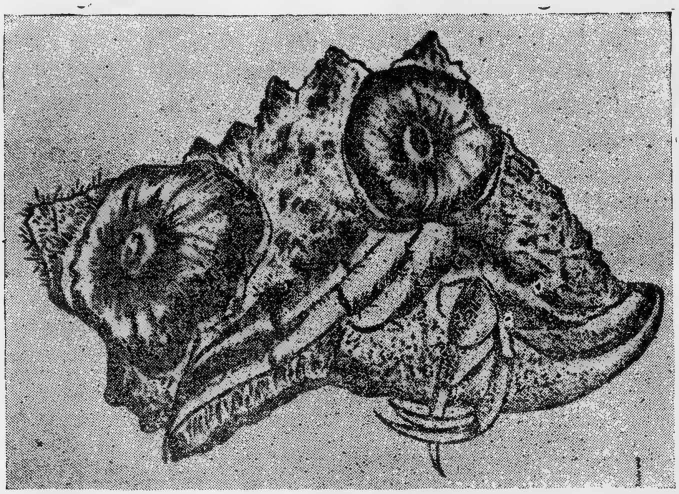

Fig. 1. Showing *Neoaiptasia commensali*, gen. et. sp. nov. on molluscan shell holding hermit crab.

Size: Shape and dimensions vary, depending on the state of expansion and also the type of substratum, to which the anemone is attached. In well expanded specimens on the shell, the size range is as follows:

Length of column—15-45 mm.
Diameter of column—5-17 mm.
Diameter of Oral Disc—20-35 mm.
Diameter of Basal Disc—20-38 mm.

Colour: Column, generally, yellowish-brown with squarish design or irregular patches or longitudinal stripes. Both the oral and the basal discs colourless, whereas, tentacles have transverse black stripes or rings.

Acontia, usually white but, at times, light-pink or flesh-coloured while the septal filaments are always white.

Basal Disc: Strongly adhesive, colourless, translucent and irregular in outline, when attached to the shell. In a well-preserved specimen, it has a circular outline. No cuticular modifications. Radial lines of mesenterial insertions, clearly visible through the wall of the disc.

Column: More or less cylindrical, not very elongated and with tentaculate margin. It is not divisible into scaphus and capitulum. Cinclides absent and, hence, the acontia are ejected out through the stomodeum. In some specimens, the colour of the column is evenly spread with a design of minute squares, whereas, in others there are irregular patches or longitudinal stripes. The ectoderm of the column is made up of high columnar cells with numerous nematocysts. Mesogloea quite thick, containing a number of fibres on the inner side and few cells on the outer side. The endoderm is made up of high columnar cells with few mucus cells and nematocysts.

Oral Disc and Actinopharynx: Oral disc is almost as wide as the basal disc, less circular in outline, with radial lines of insertions of mesenteries, clearly visible through the colourless, translucent body wall. Stomodeum sometimes elevated and with protruding lips. Actinopharynx with longitudinal shallow grooves. Siphonoglyphs two in number, always associated with directive mesenteries. Ectoderm of the actinopharynx high, containing a number of gland cells and nematocysts.

Marginal sphincter: Fairly well developed, mesogloeal and transversely stratified. It is broad at its upper part and gradually tapering downwards (Fig. 2).

Tentacles: Short, tapering with transverse stripes or dark rings formed by the algae in the endoderm. Tentacles are arranged hexamerously, in six cycles of $6+6+12+24+48+96=192$ and almost equal in length. Ectoderm of the tentacle rather thick, containing mucus cells and nematocysts. Endoderm thin in the basal part and becoming thicker towards the tip. Mesogloea thin, with numerous fibres and few undifferentiated cells.

Mesenteries: Not divisible into macro- and microcnemes and are arranged, in cycles of $6+6+12+24=48$. First two cycles i.e. 12 pairs, are perfect, sterile and with septal filaments and acontia. Third cycle of mesenteries, fertile, with septal filaments and acontia whereas the last cycle with gonads but without septal filaments and acontia. Some mesenteries distally as well as proximally. Acontia more than twice as thick as filaments and are characterized by the presence of large nematocysts. Retractor muscles diffuse, strong on the older mesenteries than on the younger ones (Fig. 3). Basilar muscles are distinct whereas parietobasilar ones are rather weak.

Sexes separate and can be distinguished in live anemone, by the colour of the gonad. Male gonad light-violet whereas female gonad yellowish or pinkish-orange in colour.

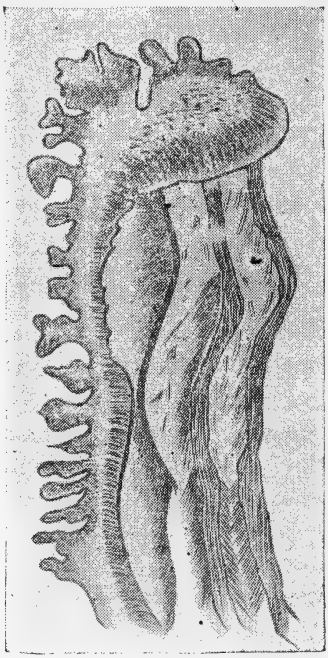

Fig. 2. Longitudinal section of marginal sphincter of *Neoaiptasia commensali*, gen. et. sp. nov.

Cnidom : Cutress (1955) is followed for the classification of nematocysts. The distribution and size (in microns) of different categories of nematocysts, are as follows :

Tentacles	
Spirocysts	9·8-21 × 1·4-2·8
Basitrichs	12·6-15·4 × 1·4
Microbasic P-mastigophores	19·6-21 × 4·2
Microbasic P-mastigophores	11·2-12·6 × 2·8
Column	
Basitrichs	19·6 × 4·2
Basitrichs	14 × 1·4
Actinopharynx	
Microbasic b-mastigophores	11·0-15·2 × 2·0-2·5
Microbasic p-mastigophores	18·2-26·6 × 4-4·5
Acontia	
Basitrichs	12·6-15·4 × 1·4-2·1
Microbasic p-mastigophores	36·4-43·5 × 6·3-7

Septal Filaments

Microbasic b-mastigophores	5·6-7×3·5
Microbasic p-mastigophores	15·4-16·8×3·5-4·2

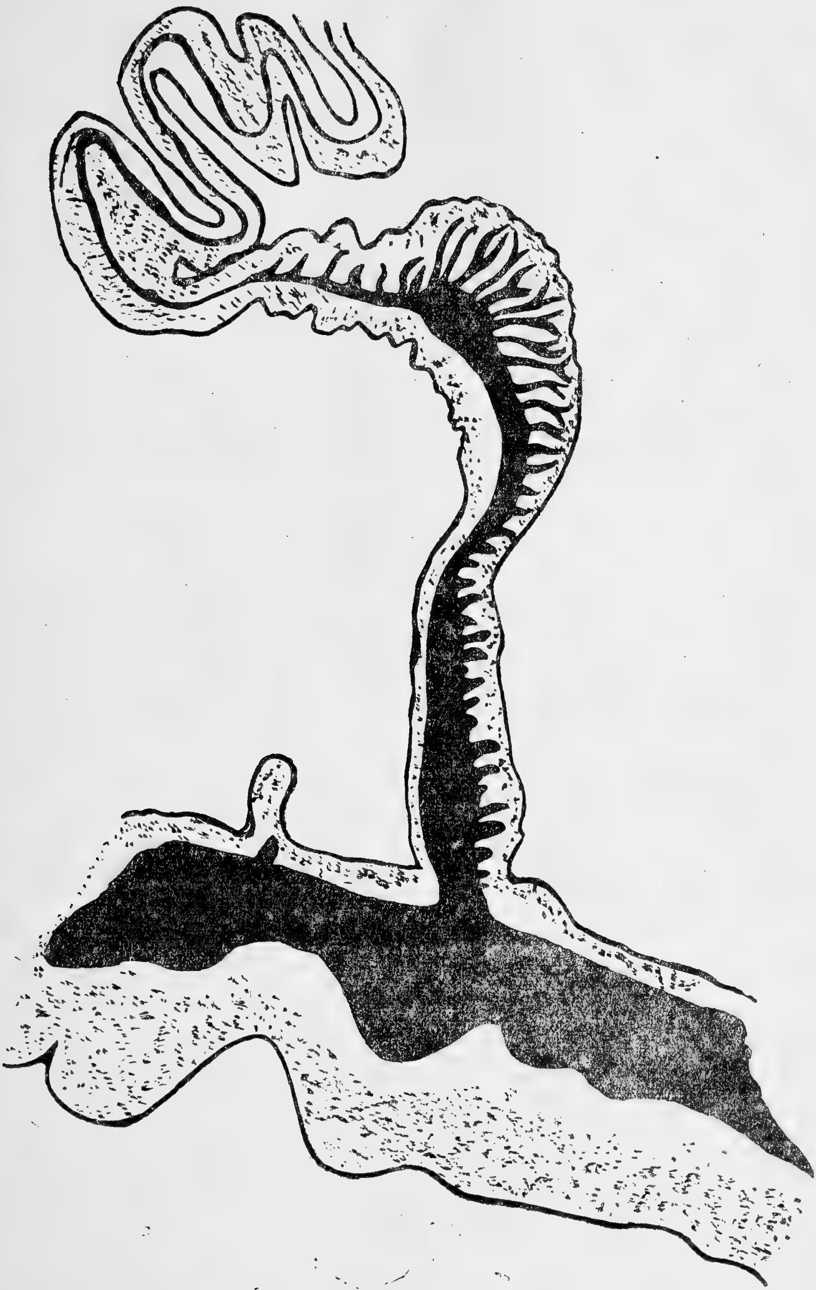

Fig. 3. Transverse Section of a perfect and imperfect mesentery of *Neoaiptasia commensali*, gen. et. sp. nov.

Remarks

The new genus possesses such characters, which makes its taxonomic position, rather difficult to settle. The presence of basitrichs and microbasic p-mastigophores in the acontia together with undifferentiated mesenteries, clearly indicates, that it is of the family Aiptasiidae. However, certain characters, such as, absence of cinclides, 12 pairs of perfect, sterile mesenteries etc. separate it from all the other members of Aiptasiidae, and in lacking cincirdes, 12 pairs of perfect, sterile mesenteries and fairly well-developed mesogloeal sphincter, the new genus closely resembles members of the family Sagartiomorphidae. Hence, at present, it seems that the genus *Neoaiptasia* is intermediate, in position between Sagartiomorphidae and Aiptasiidae and with better knowledge of the genus, it may become necessary, in future, to accommodate it in a new family.

Among the existing genera of Aiptasiidae, *Neoaiptasia*, exhibits relationship to *Aiptasia*. The common character, being the presence of smooth tentacles without any projections or protuberances.

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Some synonyms chiefly among Indian Thysanoptera

BY

J. S. Bhatti

Department of Zoology, Hans Raj College, University of Delhi, Delhi-7

(*With a plate*)

Based upon a critical study of several genera and species the present article suggests changes in the nomenclature of some Thripidae, mostly Indian. Exotic taxa having a direct bearing on a study of the Indian genera and species taken up here have naturally come under the scope of this paper. I have suggested 4 genera, 1 subgenus and 3 species to be relegated to synonymy, in addition to several new combinations.

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Genus **Rhipiphorothrips** Morgan

Rhipiphorothrips cruentatus Hood

1919, *Rhipiphorothrips cruentatus* Hood, *Insec. Inscit. Menstr.* 7 : 94-96.

1928, *Rhipiphorothrips karna* Ayyar, *Ent. Mem. Dept. Agr. India* 10 : 252-253, fig. 16.

Among a long series of *R. cruentatus* from Hoshiarpur collected on Rose leaves, Mar.-Apr. 1960, (they were clustered on the lower side and had seriously blotched the leaves), some of the specimens which were greatly pressed by coverslip pressure, show distinct pronotal 'expansions' exactly as figured and described by Ayyar for his *karna*. This character being the result of an artificial distortion, and upon which the species was based, *karna* should be relegated as a synonym of *cruentatus*. Unfortunately I did not have access to any specimen of the type or other series identified as *karna* by Ayyar. No such specimen is present in the collections of Dr. T. N. Ananthakrishnan. But there is reason to believe that *karna* was erected upon distorted specimen of *cruentatus*. Probably Ayyar had himself recognised this, since *karna* was not included in the Catalogue (1940) by Ayyar & Margabandhu. No reasons were cited for the omission by these authors or later by Shumsher (1946).

Genus **Pseudodendrothrips** Schmutz

1913, *Pseudodendrothrips* Schmutz, *Sitz. Ber. Akad. Wiss Wien* 122 : 998-999. Type *P. ornatissimus* Schmutz.

1930, *Graphidothrips* Moulton, *Rev. Chil. Hist. nat.* 34 : 272. Type *G. stuardoi* Moulton.

1936, *Halmathrips* Hood, *Rev. de Ent.* (Rio de Jan.) 6 : 248-249. Type *H. citricinctus* Hood.

1953, *Halmathrips* subgenus *Phaosothrips* Stannard, *Proc. ent. Soc. Wash.* 55 : 5. Type *H.* (*P.*) *beckeri* Stannard.

Stannard (1953, *Proc. ent. Soc. Wash.* 55 : 1-6) redescribed *Halmathrips*, but overlooked *Pseudodendrothrips* while defining its affinities. After comparing Stannard's account of *Halmathrips* with at least three species of *Pseudodendrothrips* studied by me, I believe that *Halmathrips* should be relegated as a synonym. I have also seen specimens reported by the late Dr. T. V. R. Ayyar as *Pseudodendrothrips ornatissimus* from Burma (1934, *Rec. Indian Mus.* 36 : 493). The length of hind tarsus *v.* hind tibia in *Halmathrips* (*vide* Stannard), and in *Pseudodendrothrips* examined by me has relatively the same proportion. Whether or not *Phaosothrips* should be maintained under *Pseudodendrothrips* is a problem that can be solved only after the various known species are thoroughly revised.

Graphidothrips Moulton appears to be another synonym of *Pseudodendrothrips*, notwithstanding the differences mentioned by Stannard.

The existing keys do not provide sufficient good characters for separating the Indian genera of the tribe Dendrothripini. The following key it is hoped will be useful to students of this group :

1 (2) Prosternal transverse sclerotisation entire (Figs. 1, 2). Maxillary palpi 3-segmented. Forewing thripine, with both margins curving to meet at the tip. Fore-and mid tarsi 2-segmented. Males with gland areas on abdominal sterna. .. .. *Asprothrips*

2 (1) Prosternal transverse sclerotisation divided (Figs. 3, 4). Maxillary palpi 2-segmented. Forewings variable. All tarsi 1-segmented. Males without gland areas.

3 (4) Pronotum with a transverse apodeme (complete or incomplete) in about the middle. Forewings thripine in shape. Eyes strongly bulged. Terminal antennal segments greatly elongated. .. .. *Pseudodendrothrips*

4 (3) Pronotum without such apodeme. Forewings with fore-margin curving at tip to meet the straight hind margin. Eyes normal, not bulged. Terminal antennal segments not attenuated. .. .. *Dendrothrips*

Genus **Asprothrips** J. C. Crawford

Asprothrips indicus (Bagnall) comb. nov.

1919, *Dendrothrips indicus* Bagnall, *Ann. Mag. nat. Hist.* (9) 4 : 261.

A study of cotype material (1 female, 1 male) from the British Museum and further specimens from Dr. T. N. Ananthakrishnan, shows that the species does not belong in *Dendrothrips*. A comparison with *Asprothrips antennatus* (Mlt.) (the type of *Asprothrips*), sent by Dr. Sakimura, bears out close similarities, which merit inclusion of both species in a single genus. *Asprothrips indicus* will be fully redescribed elsewhere, but a key to distinguish *A. indicus* from *A. antennatus* is given below. A new species of *Asprothrips* from Mussoorie being described elsewhere has dark dendrothripine forewings and dark brown body.

Body colour dark brown. Wings banded. Reticulations on abdominal terga close, wrinkles along ridges very prominent. (south India)... *indicus*

Body pale yellow. Wings hyaline throughout. Reticulations (clearly visible only in specimens treated in KOH) on abdominal terga rather widely spaced, wrinkles scarcely visible. (U.S.A.). .. *antennatus*

Genus **Dendrothrips** Uzel

1895, *Dendrothrips* Uzel, *Mon. Ord. Thys.*, p. 159. Type *D. ornatus* (Jabl.).

1961, *Cerothrips* Ananthakrishnan, *Zool. Anz.* 167 : 259.

Type *C. minutus* Anan.

The type series of *Cerothrips minutus* was studied. The species does not show any characters antagonistic to the present concept of the genus *Dendrothrips*, such as, the anteriorly distinctly excavated head, the dendrothripine shape of antennae, the divided prosternal sclerotisation, the metasternal furcal arms produced into a distinct lyra, the typically 2-segmented maxillary palpi (in *C. minutus*, 2-segmented and not 3-segmented as originally reported), the distinctly dendrothripine forewings, the fore marginal fringes of forewing arising much behind the costal margin, and the characteristic chaetotaxy of abdomen.

A female of *Dendrothrips ornatus* was received from the British Museum for this study.

Dendrothrips minutus (Ananthakrishnan) comb. nov.

1961, *Cerothrips minutus* Ananthakrishnan, *Zool. Anz.* 167 : 260-261, figs. 1a, A.

This species is a typical *Dendrothrips*, and by its pale coloration and 8-segmented antennae, can be readily separated from the known species of *Dendrothrips* from India. The sense cone on antennal segment 3 appears to be single, although curved, and not forked. The forewings bear 3 greyish 'spots', the first one touching neither the front nor the hind margin of the wing, and the other two only touching the costal border. The proximal of these lies beyond the basal fifth (a little beyond anal lobe), one in the middle, and the distal one in the distal third of the wing.

Of the yellow species of *Dendrothrips* with 8-segmented antennae, *minutus* has to be compared with *fasciatus* Faure (1960a) and *vitex* Faure (1960). Perhaps *minutus* is closest to *vitex*, but can be separated as follows : fore-wings with 3 greyish spots (as defined above) in *minutus*, totally transparent in *vitex* ; antennal segment 6 more slender in *minutus* than in *vitex* (length : width measured by me on one female of *minutus*, 27 : 11 μ ; in *vitex*, 21-23 : 13 μ); antennal segment 6 much longer than style (7 and 8 together) in *minutus*, segment 6 and style subequal in *vitex* (measurements taken on one female of *minutus*, length of 6 : length of style, 27 : 19 μ ; in *vitex*, 21-23 : 22 μ). From *fasciatus* our species is distinct as follows : no strong seta on posterior angles of pronotum in *minutus* (one rather long seta present in *fasciatus*) ; fore-wings transparent with only 3 greyish spots in *minutus*, in *fasciatus* 2 well defined cross bands present and the anal lobe shaded ; antennal segment 6 shorter than 5 in *minutus* (measured on one female, length of 5 : 6, 30 : 27 μ), in *fasciatus* segment 6 slightly longer than 5 (length of 5 : 6, 23 : 25 μ).

New record : Madhya Pradesh, Jabalpur district, Gwarighat village, 1 female, on grass (a straggler perhaps !), 17 Oct. 1962, coll. J. S. Bhatti. Originally described from Uttar Pradesh, taken on *Vitex negundo*.

Genus **Dantabahuthrips** Shumsher

1942, *Anaphothrips* subgenus *Dantabahuthrips* Shumsher, *Indian J. Ent.* 4 : 123-124. Type *A.* (*D.*) *sacchari* Shumsher.

1956, *Catina* Faure, *J. ent. Soc. S. Afr.* 19 : 100-101. Type *C. papyri* Faure.

1962, *Neophysopus*, Bhatti, *Bull. Ent.*, no. 3 : 46. In Part.

Dantabahuthrips is being raised to generic rank. It is readily distinguished from *Anaphothrips* (and its subgenus *Neophysopus*) by the absence of spinula on mesosternum, by having well developed medio-dorsal setae on female tergum 9 of abdomen, and only 2 thick spines in middle of male abdominal tergum 9 (4 in *Anaphothrips*). Having studied *D. sacchari* in detail and comparing it with the description of *Catina papyri*, I feel that *Catina* should be considered a synonym of *Dantabahuthrips*. But the two species remain distinct.

The genus may be characterised as follows : *Exothrips*-like, but without antennal dimorphism in the two sexes. Fore-tibial tooth absent in female, present or absent in male. Tergum 9 of male abdomen with two small closely placed rather thick spines, tergum 10 in both sexes completely split longitudinally in the middle. Prosternal transverse sclerotisation entire and thinned in the middle. Spinula lacking both on meso- and metathoracic sterna. Metasternum medially at apex rather broadly rounded.

KEY TO THE KNOWN SPECIES OF *DANTABAHUTHRIPS*:

1 (2) Body colour whitish normally. Female without fore-tibial tooth, in male distinctly present. Female: antennal segments 1-5 and proximal fourth or a little more of 6 pale, rest of antenna dark grey; apex of abdominal segment 10 dark grey. Male: antenna wholly pale yellow, although a very faint greyish shade may be present on distal two-thirds of segment 6, and all of 7 and 8. (India). .. .. *sacchari*

2 (1) Body colour yellowish. Fore-tibial tooth absent in both sexes.

3 (4) Female: antennal segments 1-3 pale yellow, 4-8 dark greyish brown, 4 lighter in proximal three-fourths, 5 and 6 in proximal half; apex of abdominal segment 10 very dark brownish. Male: antenna wholly yellow. (south India: Madras). .. *sakimurai* (Ananthakrishnan 1961)

4 (3) Female: antennal segments 1-3 pale yellow, 4 and 5 pale grey (5 darker apically), 6-8 brownish grey; apex of abdomen not dark. Male: antenna wholly yellow. (Africa: Sudan, Uganda). .. *papyri*

Dantabahuthrips sacchari Shumsher

1942, *Anaphothrips* (*Dantabahuthrips*) *sacchari* Shumsher, *Indian J. Ent.* 4: 125-127, figs.

Material of this species has come to hand from different parts of India, and it can now be stated definitely that the fore-tibial tooth said to be present in females by Shumsher, is absent in all females seen by me. Incidentally Hoshiarpur (Punjab), from where I have studied about a dozen specimens, is only *c.* 84 km. from Rupar, the type locality of the species. In male the process is present on both legs. The width of fore-femur measured on one female is 65 μ and on one male 62 μ.

The species is conspicuously whitish with no trace of yellow. But if specimens are allowed to remain in alcohol for long periods, the internal organs may assume a dirty light yellowish colour which is conspicuous through the transparent cuticle.

Exothrips tenellus Priesner 1950 needs to be compared carefully with *D. sacchari*, as that species based upon the female alone, may be identical with or at least very closely related to *sacchari.*

New records: New Delhi, 3 males on grass, 13 Apr. 1963, coll. J. S. Bhatti; Madhya Pradesh, Jabalpur District, Tewar village (west of Jabalpur), 1 female on grass, 22 Sept. 1963, coll. J. S. Bhatti.

Dantabahuthrips sakimurai (Ananthakrishnan) comb. nov.

1961, *Anaphothrips* (*Neophysopus*) *sakimurai* Ananthakrishnan, *Zool. Anz.* 167 : 261-263.

Type material of *sakimurai* was examined and found to be congeneric with *sacchari* Shumsher. The general colour of the body is yellowish, even in fresh specimens. The apex of abdominal segment 10 in female is very dark brown. The width of fore-femur measured on 2 females is 49-52 μ.

Dantabahuthrips papyri (Faure) comb. nov.

1956, *Catina papyri* Faure, *J. ent. Soc. S. Afr.* 19 : 101-105, figs. 1-5.

This interesting form has been described from Uganda and Sudan, and has been taken on papyrus. Apart from the differences noted in the key, the antennae in *papyri* are much stouter than in *sacchari* where they are rather slender. There are several other differences also in measurements. From its description it appears that the species is yellow, as compared to the whitish colour in *sacchari*. I have seen a paratype of *papyri* in the Ananthakrishnan collections.

Genus **Ramaswamiahiella** Karny

The chief characteristic upon which the genus is to be recognised as distinct from *Thrips*, is the presence of 6-7 pairs of setae on hind borders of abdominal sterna, as pointed out first by Priesner (1949, *Bull. Soc. Fouad Ent.* 33 : 61). To my knowledge few other thripids possess such numerous setae on posterior margins of abdominal sterna.

As recognised herein, only the type species, *subnudula* Karny, is included in the genus. *Ramaswamiahiella kallarensis* Ananthakrishnan (1960, *J. Bombay nat. Hist. Soc.* 57 : 564-565) is being transferred to *Thrips* by Dr. T. N. Ananthakrishnan (personal correspondence).

Ramaswamiahiella subnudula Karny

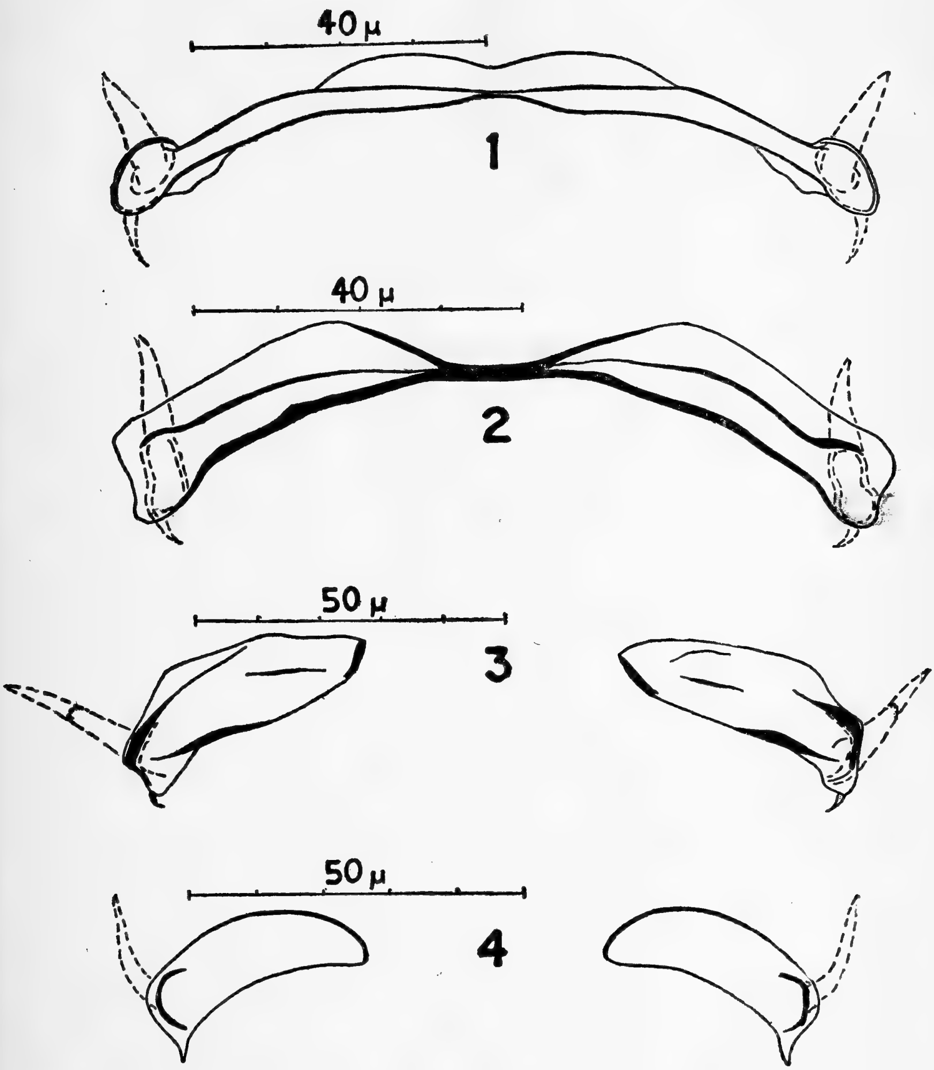
1926, *Ramaswamiahiella subnudula* Karny, *Ent. Mem. Dept. Agr. India* 9 : 208-210, fig. 11 (a-c).

1928, *Thrips pandu* Ayyar, *Ent. Mem. Dept. Agr. India* 10 : 264-265.

1929, *Thrips setosus* Moulton, *Rec. Indian Mus.* 31 : 97-98. (nec *setosus* Moulton 1928).

1951, *Thrips temporatus* Bailey, *Pan-Pacific Ent.* 21 : 9. (new name for *setosus* Moulton 1929).

The following material of this species was studied : (i) Numerous examples of both sexes in Rose flowers, New Delhi, Feb. 1962, coll.



Prosternal sclerotisation

Figs. 1. *Asprothrips antennatus* (Moulton), female; 2. *Asprothrips indicus* (Bagnall), female; 3. *Dendrothrips ornatus* (Jabl.), female; 4. *Pseudodendrothrips* sp., female.

J. S. Bhatti ; (ii) 1 female, '*Thrips subnudula*', Bangalore, Sandal, (no date), ex. T.V.R. colls. ; (iii) 2 females, '*Thrips palmi*', Mango flowers, Vizagapatnam, 22 Jan. 1928, ex. T.V.R. colls. ; (iv) 1 female, *Thrips setosus* Moulton, *Holotype*, Balighai, near Puri, Orissa, 16-20 Aug. 1911, coll. N. Annandale & F. H. Gravely, in the collection of the Zoological Survey of India (Reg. no. 155/H8). Material listed in nos. (ii) and (iii) loaned from the collections of Dr. Ananthakrishnan.

The above material bears out the synonymy of *temporatus* Bailey (=*setosus* Moulton) and *subnudula* Karny. From the description of *pandu* Ayyar, I am unable to find any characters on which it could be separated from *subnudula* and hence at present I regard it as another synonym of the widely distributed *subnudula*. The types of *pandu* were not available for this study, nor am I aware of their location.

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Studies in Leguminosae—9

A new species of *Crotalaria* L. from Bhutan Himalayas

BY

K. Thothathri

Central National Herbarium, Indian Botanic Garden, Howrah

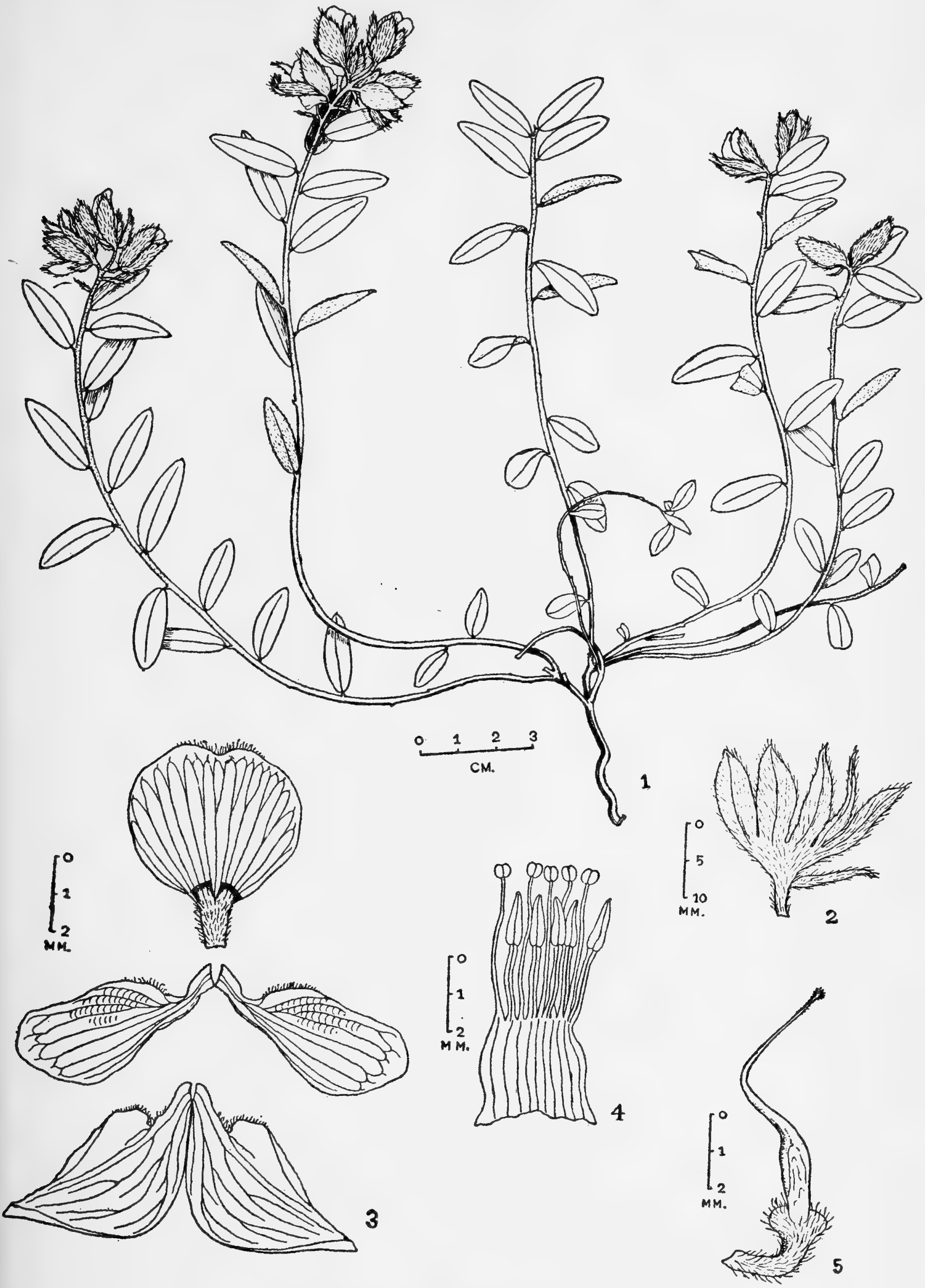
(*With a plate*)

Crotalaria bhutanica sp. nov.

Affinis *C. capitatae* Benth. a qua tamen differt foliis oblongis, brunneo-pubescentibus infra, nec leniter sericeis, racemis 5-6-floris, inflorescentia, calyce, pedicellis, bracteis brunneo-pubescentibus, nec ferrugineis.

Suffrutex humilis, 25-30 cm. altus, ramificans ex infimo caule, griseo-pubescens. *Folia* simplicia, alterna, inferiora quidem minora, obovata, plus minusve sessilia, superiora vero ampliora, oblonga et petiolata, 1·3-2·5×0·7-0·8 cm., exstipulata, acuta et mucronata ad apicem, angustata vel rotundata ad basin, parce adpresso-pilosa supra, dense infra ; petioli 1-2 mm. longi ; nervi laterales haud distincti. *Inflorescentia* capitulum terminale densum racemosum constans floribus 5-6, 2-3×2·5-3·0 cm. *Flores* violacei, 1·5 cm. longi, pedicellati ; pedicellis 3-4 mm. longis ; bracteae lineares, 3-4 mm. longae, pubescentes ; bracteolae binae, lineares, 3-5 mm. longae, quarum una ad basin calycis, altera ad medium pedicelli, pubescentes. *Calyx* extus pubescens, glaber intus, tubo brevi, bilabiatus, lobis binis labii superioris oblongis, 1·2-1·4 cm. longis, ternis lobis labii inferioris lanceatis, 1·2-1·3 cm. longis. *Corollae* vexillum ovato-orbiculare, unguiculatum, 1·2-1·4 cm. longum, callositate duplici ad basin supra unguem, lamina glabra, sed parce pilosa ad apicem extus, ungue dense pubescente intus ; alae oblongae, 1·0 cm. longae, unguiculatae, glabrae ; carinae connatae praeter infimam partem, 1·0 cm. longae, incurvae, rostratae, margine superiore ad medium piloso. *Stamina* 10, monadelpha, columna 7-10 mm. longa, antheris dimorphis, brevibus quidem versatilibus filamento gracili insidentibus, alternantibus cum longis basifixis filamento complanato insidentibus. *Pistillus* 1·2 cm. longus, ovario sessili, glabro, stylo gracili, incurvato ad basin, barbato ; stigmate minuto, piloso ; ovula plura. *Legumina* ignota.

Typus lectus in via ad Tabachettu, Thimpu, die 18 septembris anni 1964, et positus in CAL sub numero *Abraham* 2382.



Crotalaria bhutanica sp. nov.

1. Entire plant with flowers; 2. Calyx lobes spread open with the bracteole; 3. Corolla with standard, wing and keel petals; 4. Staminal column spread; 5. Pistil showing ovary, style and stigma.

Crotalaria bhutanica sp. nov.

Crotalaria bhutanica is related to *C. capitata* Benth. but differs in leaves being oblong, brown pubescent below and not finely silky as in the latter, raceme being 5-6 flowered and inflorescence, calyx, pedicel and bracts brown pubescent and not ferruginous silky pubescent as in the latter.

A low undershrub, 25-30 cm. high, branches tufted from the root stock, grey pubescent. *Leaves* simple, alternate, lower leaves smaller, obovate and more or less sessile while upper leaves larger, oblong and petiolate, 1·3-2·5×0·7-0·8 cm., exstipulate, acute and mucronate at apex, narrow to rounded at base, sparsely adpressed hairy above, densely adpressed pubescent below; petiole 1-2 mm. long; lateral veins not distinct. *Inflorescence* a terminal, congested racemose head of 5-6 flowers, 2-3×2·5-3·0 cm. *Flowers* violet, 1·5 cm. long, pedicellate; pedicels 3-4 mm. long; bracts linear, 3-4 mm. long, pubescent; bracteoles 2, linear, 3-5 mm. long, one at the base of the calyx cup and another at the middle of the pedicel, pubescent. *Calyx* pubescent outside, glabrous inside, tube short, bilipped, 2 lobes of the upper lip oblong, 1·2-1·4 cm. long, 3 lobes of the lower lip lanceolate, 1·2-1·3 cm. long. *Corolla* standard ovate-orbicular, clawed, 1·2-1·4 cm. long, blade with 2 callosites at its base just above the claw, blade glabrous but sparingly hairy on top outside, claw densely pubescent inside; wings oblong, 1·0 cm. long, clawed, glabrous; keels connate except below, 1·0 cm. long, incurved, beaked, upper margin hairy in the middle. *Stamens* 10, monadelphous, column 7-10 mm. long, anthers dimorphous, short versatile ones with slender filaments alternating with long basifixed ones with flattened filaments. *Pistil* 1·2 cm. long, ovary sessile, glabrous, style slender, incurved at base, bearded; stigma minute, hairy; ovules many. *Pod* not known.

Type: On way to Tabachettu, Thimpu, 18-9-1964—*Abraham* 2382 (CAL).

ACKNOWLEDGEMENTS

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The nidification of some common Indian Birds—Part 12

BY

B. S. LAMBA
Zoological Survey of India, Western Regional Station, Poona

12. THE KOEL [*Eudynamys scolopacea* (Linn.)]

INTRODUCTION

The inclusion of the Koel, *Eudynamys scolopacea* (Linn.), in the nidification series, I am afraid, is rather inappropriate as the Koel never builds a nest being a brood parasite. The Koel, for this purpose has selected the most intelligent of the Corvidae and perhaps the most devoted of avian parents the House Crow, *Corvus splendens* Vieillot. Not infrequently it cuckolds the not so bright first cousin, the Jungle Crow, *Corvus macrorhynchos* Wagler and occasionally its distant kin the Magpie, *Pica rustica* (Harington 1904). Instances are also on record when it made use of the nest of the Common Myna, *Acridotheres tristis* (Linn.) (Inglis 1908 : 681); Golden Oriole, *Oriolus oriolus* (Linnaeus) (D'Abreu 1927) ; Black Drongo, *Dicrurus adsimilis* (Bechstein) (Smith 1952) and Starling, *Gracupica* (Baker 1927).

Breeding season.

The breeding season of the Koel, for obvious reasons, coincides with that of the House Crow, throughout the country. In fact it starts a little early when most House Crows are still at the nest building stage and some sluggard Jungle Crows are still laying. It is these tardy Jungle Crows that get cuckolded. The breeding seasons of the two species of crows have already been described at length elsewhere (Lamba 1963, 1965). Broadly speaking the breeding season of the Koel is from May to July, beginning a little early in southern India and ending a little late in northern India.

At Poona where the present study was undertaken the Koel lays mostly in the months of May and June. Fresh eggs were taken from the nests of the Jungle Crow, as early as 19 April and from the nests of House Crow, as late as 1st July. Instances of courtship display, pair formation and copulation were observed as early as the first week of April.

Territory.

Early in the breeding season the male, apparently, establishes a territory in a promising patch of trees abounding in crows and announces it by its lusty song. The female, in response to the call visits the territory and stays on, presumably, if she happens to like it. This territory is defended by both but with different consequences. Any trespassing/visiting female is welcomed by the male. The female on the other hand greatly resents such visitors and never fails to see it off the area. Whereas a visiting male is given all encouragement by the female. The male, however, immediately asserts its ownership of the area. Even the unmated males defend their established territory against any male intruder. It is quite usual for a number of unmated males who presumably could not establish or hold their territories to spend time together in a single large tree.

Defence.

The male when defending the territory gradually approaches its adversary, hopping from twig to twig, calling loudly and displaying its threatening posture. The threatening display consists of slight spreading of the wings and shaking them, jerking the head in a stabbing movement and flicking and waving the tail. The intruder too strikes a similar posture and calls back without giving ground. When they are within striking distance beaks are used as the main weapons of offence and defence. The stabbing jabs are interspersed with loud, presumably, threatening calls. The duel goes on for minutes together, the length depending upon the tenacity of the intruder or the ferocity of the defender and ends only with the withdrawal of one of the combatants, usually the intruder. The retreating trespasser is normally chased out of the territory.

The female's method of defending the territory, is about the same as that of the male, but never becomes as violent as between fighting males. After a while the trespassing female gets bored and leaves. The trespassing female may or may not be chased by the female but is more often than not chased by the male if he happens to be around perhaps for entirely different reasons.

Pair formation.

To all appearances the koels pair only for the breeding season and that too not very seriously. As has been described, others of the opposite sex are courted and copulated with by both. This behaviour of the koel has often been commented upon (Dharmakumarsinhji 1954 ; MacDonald 1960). The courtship consists of the male chasing the female, both calling. The chase often ends up in the female surrendering on a branch of a tree. She is often fed by the male after every coition, occasionally even before the act. The copulation is done in the normal bird fashion always in the branches of trees, sometimes even in the vicinity of a crow's nest under construction (MacDonald 1960 : 130).

Egg laying.

The egg or eggs are laid in the nest of host species at a comparatively early stage, when the host has just started laying. During the course of this study it was observed that (i) out of twenty-one crow's nests a koel managed to lay in sixteen nests her first egg after the crow had laid one, in three nests after the crow had laid two and in two nests after the crow had laid three. (ii) In three nests of the Jungle Crow, the koel laid her first egg after the crow had laid its first. No koel's egg was seen in a freshly completed crow's nest, not containing an egg of the owner. From various observations it is surmised that the female koel keeps an eye on the progress of the nest or nests of crows in her territory. She takes her cue for laying from the commencement of incubation by crows who are in the habit of starting to brood as soon as the first egg is laid. Thereafter she lays her egg at the first possible opportunity. If she is lucky to get a break within first twenty-four hours of her observation of the brooding crow she manages to lay after the crow has laid her first egg, otherwise after the second or third.

Clutch size.

I have personally never come across more than three Koel's eggs (of a single type presumably the product of a single bird) in a nest of the host species and hence I am inclined to believe that normally two and not more than three eggs are laid by a single female koel, at least in a nest of the hosts. Some previous workers, however, did come across as many as seven (Jacob 1915), eleven (Abdulali 1931) and thirteen (Jones 1916 ; Baker 1934) koel's eggs of two or three distinct types (presumably the product of as many birds) in a single crow's nest, out of which a maximum of five (all of one type) have been assumed (Jacob 1915) to be the product of a single female.

Laying method.

Dewar (1906) believed that the male and female Koel employed a well planned subterfuge to lay in the nest of the vigilant house crow. Since then numerous other workers, (Lamba 1963 : 131) have observed a pair of koels flying in different directions when attacked by crows (the male more often than the female being chased by the crows), but were not lucky enough like Dharmakumarsinhji (1954 : 136) to observe the female koel slipping into the crow's nest when the owners were busy chasing the male accepted this theory on circumstantial evidence.

In May 1966, I made an observation which made me seriously doubt the earlier theory. During observations on incubating house crows at Poona in 1953-55, I had observed that the female sat on the eggs throughout the night while the male roosted in the same or a nearby tree. The female left the nest at the first hint of light from the east. After leaving the nest she usually perched at the top or on an outside branch of the nest tree or a nearby tree, preening her feathers, and patiently waiting for her mate to show up. In 1966 I repeated similar observations on the Jungle Crow. On 3 May 1966, while observing a Jungle Crow's nest at Gul Tekdi, Poona, at dawn I saw a shadowy form slip into the nest soon after the female left it to perch at the top of the nesting tree. As the visibility was poor I took it to be the male crow taking up his duty. However, a careful scrutiny revealed a much longer tail projecting out of the nest, and a full view of a female koel leaving the nest. I had had this particular nest under observation for the previous fifteen days or so and had checked it only the previous day and marked the single egg laid on 2nd morning. Being greatly excited by what I had seen I checked the nest again and found a freshly laid (still warm, in fact warmer than the crow's egg) koel's egg lying next to the previously marked crow's egg. The incident posed a number of questions. (i) Was it a stray incident ? or (ii) Was it the usual mode and time of laying ? or (iii) Was the dawn laying adopted only in the case of nests of the habitually unsuspecting Jungle Crow ? I decided to pursue the matter further by watching fresh House Crow nests (the main host of the koel) in the coming nesting season for similar occurrences. With the breeding season of House Crow closely following that of the Jungle Crow I did not have to wait for long and I saw the same behaviour repeated twice during the breeding season of 1966 in the House Crow's nests but not as smoothly as in the case of the less suspicious and less vigilant Jungle Crow. The house crows, in one instance, detected the koel as she entered their nest and drove her off before she could lay.

The observations coupled with my earlier observations induce me to believe that :—

(1) The koels have no definite and well worked out method to dupe the crows. The female koel takes advantage of every temporary absence or distraction of crows from their nest to lay her egg, making full use of her colour to accomplish the act in the grey light of dawn. She is equally alive to the chances offered by crows while they are actively chasing another koel.

(2) The house crows chase both sexes of koel indiscriminately.

My belief is further strengthened by the following facts and reasons :—

(i) Although practically sixty years have passed since the subterfuge theory was first advocated (Dewar 1906 : 219-220) yet not a single ornithologist, with exception of Dharmakumarsinhji (1954 : 136), who mentions seeing a 'pair of crows chasing a male koel while the female entered the nest' but does not confirm if they (koels) were of a pair, has been able to confirm it by observation.

(ii) The subterfuge theory takes it for granted that the House Crow distinguishes by sight the male Koel without enumerating any reasons, presumably assigning it to instinct. This does not explain how the female koels get so often (Hume 1890 : 393 ; Anderson in Hume 1890 : 394 ; Butler in Hume 1890 : 395 ; Dharmakumarsinhji 1954 : 136 ; MacDonald 1960 : 131 ; Lamba 1963 : 131) assaulted by house crows or how the jungle crows who do not go after the koels get cuckolded ? I do not think that it is correct to assume that one species of hosts (House Crow) is thus benefited over another (Jungle Crow). On the other hand this behaviour apparently is due to the inherent alertness of the House Crow (who often catch koels red-handed entering the nest and never forget to chase any, seen afterwards) and a comparative lack of these qualities in the Jungle Crow.

(iii) The koel becomes active very early in the morning and as birds are generally known to prefer mornings for laying it is only natural for the koel to lay early in the morning. Had the laying been confined to the hours of daylight (crows have to see a koel to give chase) only, the koel should normally have started the day along with the other species of birds and not comparatively earlier.

It has also been suggested by a number of earlier workers that the koel removes one of the crow's eggs at the time of laying its own or subsequently, if it gets the opportunity (Butler in Hume 1890 : 395 ; Dewar 1907 : 781 ; Baker 1934 : 359). Although I have thrice witnessed the actual laying by koels, yet, not even once have I seen the koel removing or destroying any of the crow's eggs at the time of laying her own. The argument that it did not possibly have sufficient time at the time of laying and might have destroyed one or more of crow's eggs afterwards is effectively countered by (i) my subsequent observations of all the three nests where no eggs were missed and (ii) koel's questionable ability to differentiate her own eggs (which she does not even see at the time of laying as she is in an infernal hurry to get away) from that of the crow's at subsequent visits. I am therefore of the view that the koel does not tamper with the contents of crow's nest at the time of laying her egg or subsequently. The disappearance of one or more of crow's eggs from a nest under observation needs some other explanation.

The egg.

The eggs are in shape moderately broad oval, and somewhat compressed towards the smaller end. The shell is fine and glossless in texture. The ground colour varies from pale sea green to dull olive green often with a brownish tinge. They are marked all over with specks, spots, streaks, blotches and clouds of reddish brown, warm brown or purple, more so towards the broader end where the markings sometimes take the form of an undefined cap. The size varies from 28-32 mm. × 22-24 mm. Twenty-one eggs averaged $30{\cdot}8 \times 23{\cdot}2$ mm.

Period of incubation.

The period of incubation for koel's eggs as studied in 12 cases was found to be 13 days, the same as reported previously (Lamba 1963 : 132). Apparently the koel capitalizes on this shorter incubation period, 13 days as compared to 16-17 days of House Crow (Lamba 1963 : 128) and 18-20 days of Jungle Crow (Lamba 1965 : 430). It usually lays after the crow has laid its first egg therefore the young koel is the first to emerge. Even when the koel has been as late to lay as after the crow's third egg the young koel hatches out along with the first of crows, getting a fair chance to compete with the foster parents young.

Fertility.

The fertility in the koel's eggs as studied in 39 cases was found to be cent per cent. Never in my twelve years of experience have I come across a koel's egg that failed to hatch. This absolute fertility is perhaps due to its parasitic habits (survival value). They cannot, obviously, afford to lay infertile eggs in the nests of the hosts for which they have to work so hard and get so meagre an opportunity.

Nestling.

The young koel normally hatches a day or two earlier than the crows'. At emergence it weighs approximately 7 gm. Born naked, the skin is brownish in colour as compared to the pink of the crow fledglings. The eyes are closed. The colour of the beak and claws is the same as that of the body. The tip of the beak and claws are whitish and hard. Once an egg (in advanced stage of incubation) hatched out after it had been kept in a steel almirah for twenty-four hours. The nestling could be heard from inside of the shell approximately four hours before it broke the shell to emerge. At emergence it could emit a weak sound and could raise its neck (when touched) to gape for food.

Care and feeding by fosterers.

The crows start feeding the koel nestling with the zeal and enthusiasm of devoted parents. For the first couple of days it is fed on semi-liquid, regurgitated food. After about three days the nestlings are able to swallow soft solids. The food comprises mainly of soft bodied animals (caterpillars, worms, centipedes, etc.), kitchen scraps, grains, fruits and similar vegetable matter. Both foster parents bring food for and feed the young koel. The feeding trips are so arranged as to leave one of them in immediate vicinity of the nest to guard against predators. As many as ten feeding trips an hour may be made.

As a result of this assiduous care the young koel grows rapidly and is the healthiest occupant of the crow's nest. By the end of the first week its weight increases seven to eight times the weight at emergence.

By the end of the second week the body weight of the koel nestling increases by twelve times and at the end of the fourth week, when the young koel is ready to leave the nest, it weighs about 120-125 gm. approximately 16-18 times its weight at emergence.

Plumage.

As already stated the young koel is practically devoid of feathers at emergence though a few neossoptiles may be discovered on dorsal feather tracts on very minute examination. The contour feathers, remiges and rectrices start piercing the skin by the end of the first week in the form of blunt needle-like structures. By the middle of the second week the ends of these needle like structures, break open into small tufts which gradually elongate into rachis and vane. By the end of the fourth week the young are fully fledged. The sexes can be differentiated by the middle of the second week when the females start showing their dots (above) and bars (below) and their colour remains dark brown. The males on the other hand remain uniform black except for a row of whitish dots across the wing coverts. The general coloration of the fully fledged young is somewhat similar to the adults, but slightly darker in the female nestlings.

Nestling behaviour.

The young koel, unlike other young cuckoos, does not eject the eggs or young of the host species. This fact was recorded as early as 1907 by Dewar who at that time held an enquiry into the parasitic habits of the koel (Dewar 1907). The only unfair advantage the young koel takes is that it emerges a little earlier than its foster brethren and by the time they hatch out it is already big enough to raise its neck oftener and higher to draw the attention of the foster parents as they arrive at the nest with food. The foster parents without making any distinction thrust the food down the nearest gaping mouth. The young koel seems to have an insatiable hunger and goes on greedily devouring a large percentage of the food brought by the crows, depriving the young crows of their share of the much needed food during the critical first week. As a result, all but one, occasionally two, young crows die of starvation when their parents are fostering a koel. When the number of young koels happens to be two rarely a young crow can manage to survive.

The young koel otherwise lives in amity with the young crow/crows, if any manages to survive, and leaves the nest along with them after about four weeks of nest life. Even after leaving the nest it follows its foster parents from tree to tree demanding food. Although not well adapted for terrestrial movement, it often alights on a stone or boulder to ask for food when the foster parents are feeding on the ground. The procedure for asking food is the same as of the young crows. It can even manage a hoarse caw very much resembling that of the young crow's. When the young koel is going about after its foster parents it also tries to feed itself independently on ficus figs and the like. Presumably it breaks away from the fosterers after it acquires enough self-confidence to feed by itself.

Nestling Mortality.

The nestling mortality is extremely rare in koels. I have never come across a dead koel nestling in a crow's nest. I wonder if any ever die of starvation. Unless, of course, there happen to be more than two or three of them in a single nest and one (or more) of them is (or) rather late to hatch out. In such a case the last to emerge may not have enough opportunity to obtain food from the foster parents and may perish as a consequence. Natural calamities (like accidental fall as a result of storm) ; interference by small inquisitive boys and disease appear to be the main causes of nestling mortality in koel. I have missed only one koel nestling during the period of study when twenty-one nests containing twenty-four koel fledglings were under observation. The ratio works out roughly to 4·2 per cent.

Parent koel's behaviour.

Apparently the koel, after having laid her egg/eggs in a crow's nest, forgets all about it. She does not make any attempt to feed her own young after they hatch out or subsequently when they finally leave the crow's nest. It is, however, a common belief in Punjab that the koel keeps in the vicinity of the nest in which it has laid and takes charge of its young as soon as it leaves the nest. This belief has, so far, been substantiated by actual observation only by Hume. He (Hume 1890 : 393) writes ' One curious fact remains to be noticed. I have never seen crows feeding fully fledged koels out of the nest, whereas I have repeatedly watched adult female koels feeding young ones of their own species. I am pretty nearly convinced that after laying their eggs the females keep somewhere about the locality and take charge of the young directly they can leave the nests'. I have not come across, so far, an adult female koel feeding a young koel.

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Spider Fauna of India: Catalogue and Bibliography

BY

B. K. TIKADER
Zoological Survey of India, 8, *Lindsay Street, Calcutta*-16

This paper contains a systematic list of species, and the literature references, of the spiders occurring in India. 382 species, contained in 123 genera of 30 families, are listed.

INTRODUCTION

More than ninety years have passed since the study of Indian spiders was first taken up by European arachnologists. Although spiders are extremely abundant throughout the country, our knowledge of the Indian forms is extremely fragmentary. One of the earliest contributions on Indian spiders was by Stoliczka (1869). Simon (1889), Cambridge (1869) and Karsch (1873) reported many interesting forms from India, Ceylon and Minicoy Islands. Thorell (1895) published a descriptive catalogue of over two hundred species of Burmese spiders, including about 150 new species. Pocock (1899-1901) recorded hardly two hundred species from India, Burma and Ceylon. Sherriffs (1927-1951) described numerous interesting species from south India. Gravely (1912-1935) added considerably to our knowledge of Indian spiders, particularly Lycosidae, Ctenidae, Clubionidae etc. A number of species from Lahore were described by Dyal (1935). Narayan (1915) gave interesting accounts of many ant-like spiders of the family Salticidae and recorded the occurrence of several remarkable forms in India. Recent studies on the Lycosidae, Argiopidae and Hersiliidae by Sinha (1951-1952) may also be mentioned as important contributions to our knowledge of arachnology of India. Very recently Tikader (1960-1969) described a number of species of the various families from India. Sen (1963) and Basu (1963-65) are also working on the spider fauna of India.

In the field of spider taxonomy, revision of genera and species, description of new species and investigation of fauna, etc. have been kept up by several pioneering arachnologists, whose work has thrown much light in the various field of arachnology. But unfortunately it is not ascertained yet, however, how many species there are in Indian subcontinent, nor can a complete list of known Indian spiders be found.

Therefore the author, has now attempted to prepare a tentative list of them based on the data which he possesses as a result of his examination both of literature and of the specimens obtained by him in the course of many years. The present report comprises a list of Indian spiders and their distribution and type information as far as it is available to him.

Still it is very difficult to make a complete list at present, for there are some families of Indian spiders that have yet to be re-examined. It would gratify the author, if this list would serve in some measure as a stepping stone for the future advancement of arachnology in India. During the past fifteen years the author has concentrated his energy upon the pursuance of this study. However, this has been possible only through the kindness and courtesy of many learned and experienced people in the field of arachnology. In the catalogue section of this paper, families, genera and species are listed alphabetically for convenience.

The bibliography at the end contains 105 titles dealing with Indian spiders. These titles are arranged alphabetically, authorwise and numbered serially.

Abbreviations and symbols : Question mark '?' indicates the information of type deposit are not known or very little information is available. ZSI (Zoological Survey of India, Calcutta). BMNH [British Museum (Natural History), London]. MNHN (Museum National d' Histoire Naturelle, Paris).

CATALOGUE OF INDIAN SPIDERS

Family AGELENIDAE

Genus *AGELENA* Walcknaer 1805

1. **Agelena gautami** Tikader 1962. *J. Linn. Soc. London* **44** : 569, fig. 2.

   Distribution : India : Shillong, Assam.
   Type : ZSI.

Genus *TEGENARIA* Latreille 1804

2. **Tegenaria lunakensis** Tikader 1964. *Rec. Indian Mus.* **59** (3) : 258, fig. 1a-d.

   Distribution : India : Lunak, Central Himalaya.
   Type : ZSI.

Family ARGIOPIDAE

Genus *ARANEUS* Clerck 1757

3. **Araneus bilunifer** Pocock 1900. FAUNA BRIT. INDIA *Arachnida*, p. 227, fig. 74.

Distribution : India : Madras State.

Type : BMNH.

4. **Araneus dehaanii** (Doleschall) 1859.

Epeira dehaanii Doleschall 1859. *Verh. Nat. Vereen. Nederl.* **5** (5) : 33, fig. 7.

Distribution : India : Kerala, Mysore, West Bengal, Assam ; Sikkim ; Burma ; Austro-Malaysia.

Type : ?

5. **Araneus laglaizei** Simon 1877. *Ann. Soc. Ent. France* **7** (5) : 77.

Distribution : India : Ootacamund ; Burma ; Austro-Malaysia.

Type : MNHN.

6. **Araneus mitifica** (Thorell) 1887.

Epeira mitifica Thorell 1887. RAGNI BIRMANI p. 187.

Distribution : India : West Bengal, Mysore and Maharashtra; Burma.

Type : BMNH.

7. **Araneus nauticus** Koch 1875. *Aegypt. Abyssin. Arachn.*, p. 17, fig. 2.

Distribution : India : Poona, Darjeeling, Eastern Khandesh ; Burma.

Type : ?

8. **Araneus rumpfi** Thorell 1878. *Ann. Mus. Genova* **13** : 296.

Distribution : India : Madras, Bangalore, Poona ; Burma ; Austro-Malaysia.

Type : BMNH.

9. **Araneus unicolor** (Doleschall) 1857.

Epeira unicolor Doleschall 1857. *Nat. Tijdschr. Nederland* **13** : 419.

Distribution : India : Nagaland ; Ceylon ; Burma.

Type : ?

Genus *ARGIOPE* Savigny 1809

10. **Argiope aemula** (Walck.) 1837.

Epeira aemula Walck. 1837. *Ins. Apt.*, **2** : 118.
=*Argyope aemula* Pocock 1900. FAUNA OF BRIT. INDIA *Arachnida*, p. 223.

Distribution : India: Kerala, Madras, Mysore, Maharashtra, Gujarat, Nicobar Islands ; Ceylon; Burma; Malaysia.

Type : ?

11. **Argiope anasuja** Thorell 1887. *Ann. Mus. Genova* **25** : 162.

=*Argyope anasuja* Pocock 1900. FAUNA BRIT. INDIA *Arachnida*, p. 222.

Distribution : India : Madras, Maharashtra, Orissa, Bihar, West Bengal ; Ceylon.

Type : BMNH.

12. **Argiope arcuata** Simon 1884. *Ann. Mus. Genova* **20** : 343.

=*Argyope arcuata* Pocock 1900. FAUNA BRIT. INDIA *Arachnida*, p. 220.

Distribution : India : Rajasthan, Maharashtra, Mysore ; Burma.

Type : MNHN.

13. **Argiope catenulata** (Doleschall) 1859.

Epeira catenulata Dol. 1859. *Verh. Nat. Vereen. Nederland*, **5** (5) : 30, fig. 1.
=*Argyope catenulata* Pocock 1900. FAUNA BRIT. INDIA *Arachnida*, p. 223.

Distribution : India : Salt lake near Calcutta, Nicobar Islands ; Ceylon ; Burma ; Austro-Malaysia.

Type : ?

14. **Argiope kalimpongensis** Sinha 1951. *Rec. Indian Mus.* **49** : 77, fig. 3a-c.

Distribution : India : Sibsagar, Assam, Coorg, Darjeeling, Kalimpong.

Type : ZSI.

15. **Argiope lalita** Sherriffs 1928. *Ann. Mag. Nat. Hist.* (10) **2** (8) : 186, figs. 3-7.

Distribution : India : Mysore, West Bengal.

Type : BMNH.

16. **Argiope lobata** (Pallas) 1772.

Aranea lobata Pallas 1772. *Spic. Zool.* **1** (9) : 46, fig. 14.
=*Argyope lobata* Pocock 1900. FAUNA BRIT. INDIA *Arachnida*, p. 221.

Distribution : India : Mysore, Madhya Pradesh.

Type : ?

17. **Argiope pradhani** Sinha 1951. *Rec. Indian Mus.* **49** : 76, fig. 2a-c.
Distribution : India : Saran, Bihar, Shillong, Assam.
Type : ZSI.

18. **Argiope pulchella** Thorell 1881. *Ann. Mus. Genova* **17** : 74.
=*Argyope pulchella* Pocock 1900. FAUNA BRIT. INDIA *Arachnida*, p. 221.
Distribution : India : Assam, West Bengal, Orissa, Bihar, Kerala, Maharashtra, Mysore, Madras, U.P.
Type : BMNH.

19. **Argiope shillongensis** Sinha 1951. *Rec. Indian Mus.* **49** : 75, fig. 1a-c.
Distribution : India : Assam, Shillong.
Type : ZSI.

20. **Argiope undulata** Thorell 1887. *Ann. Mus. Genova* **25** : 154.
=*Argyope undulata* Pocock 1900. FAUNA BRIT. INDIA *Arachnida*, p. 222.
Distribution : Andaman Islands ; Burma ; Malay Peninsula.
Type : BMNH.

Genus *CHORIZOPES* Cambridge 1870

21. **Chorizopes anjanes** Tikader 1965. *Proc. Indian Acad. Sci.* **62** : 94, fig. 2a-d.
Distribution : India : Poona, Maharashtra.
Type : ZSI.

22. **Chorizopes khanjanes** Tikader 1965. *Proc. Indian Acad. Sci.* **62** : 95, fig. 3a-c.
Distribution : India : Poona, Maharashtra.
Type : ZSI.

Genus *CLADOMELEA* Simon 1895

23. **Cladomelea mundhva** Tikader 1962. *Proc. Indian Acad. Sci.* **57** : 97, fig. 2a, b.
Distribution : India : Poona, Maharashtra.
Type : ZSI.

Genus *CYCLOSA* Menge 1866

24. **Cyclosa bifida** (Dol.) 1859.
Epeira bifida Dol. 1859. *Tweede Bijdr.* p. 38.
Distribution : India : Shillong ; Burma ; Singapore.
Type : ?

25. **Cyclosa confraga** (Thorell) 1892.

Epeira confraga Thorell 1892. *Novae species Aranearum*, p. 31.

Distribution: India : Poona, Mysore, Assam, Sikkim and Burma.

Type : BMNH.

26. **Cyclosa insulana** (Costa) 1834.

Epeira insulana Costa 1834. *Cenni. Zool.* etc., p. 65.

Distribution : India : Maharashtra, Mysore, West Bengal, Assam, Gujarat, Sikkim; Nepal ; Ceylon and Burma.

Type : ?

27. **Cyclosa moonduensis** Tikader 1963. *J. Poona Univ. Sci. & Tech.* **24** : 44, fig. 5a, b.

Distribution : India : Poona, Maharashtra.

Type : ZSI.

28. **Cyclosa mulmeinensis** (Thorell) 1887.

Epeira mulmeinensis Thorell. RAGNI BIRMANI, p. 221.

Distribution : India : Maharashtra and Mysore States ; Burma.

Type : BMNH.

Genus *CYRTARACHNE* Thorell 1868

29. **Cyrtarachne avimerdaria** Tikader 1963. *J. Bombay nat. Hist. Soc.* **60** : 269, fig. 1a-c.

Distribution : India : Cherrapunji, Assam.

Type : ZSI.

30. **Cyrtarachne bengalensis** Tikader 1960. *J. Bombay nat. Hist. Soc.* **57** : 550, fig. 3a-c.

Distribution : India : Sibpur Botanical Garden, West Bengal.

Type : ZSI.

31. **Cyrtarachne biswamoyi** Tikader 1960. *J. Bombay nat. Hist. Soc.* **57** : 554, fig. 5a-c.

Distribution : India : Mukki, Balaghat Dist., Madhya Pradesh.

Type : ZSI.

32. **Cyrtarachne gravelyi** Tikader 1960. *J. Bombay nat. Hist. Soc.* **57** : 553, fig. 4a-c.

Distribution : India : Darjeeling, West Bengal, Manipur, Assam.

Type : ZSI.

33. **Cyrtarachne inaequalis** Thorell 1895. SPIDERS OF BURMA, p. 201.
Distribution : India : West Bengal, Madhya Pradesh, Manipur, Assam ; Burma ; Japan.
Type : BMNH.

34. **Cyrtarachne promilai** Tikader 1963. *J. Bombay nat. Hist. Soc.* **60** : 274, fig. 4j-1.
Distribution : India : Poona, Maharashtra.
Type : ZSI.

35. **Cyrtarachne raniceps** Pocock 1900. FAUNA BRIT. INDIA *Arachnida*, p. 229.
Distribution : India : West Bengal, Maharashtra, Mysore ; Ceylon.
Type : BMNH.

36. **Cyrtarachne schmidi** Tikader 1963. *J. Bombay nat. Hist. Soc.* **60** : 271, fig. 2d-f.
Distribution : India : Kameng, N.E.F.A.
Type : ZSI.

37. **Cyrtarachne sundari** Tikader 1963. *J. Bombay nat. Hist. Soc.* **60** : 273, fig. 3g-i.
Distribution : India : Poona, Maharashtra.
Type : ZSI.

Genus *CYRTOPHORA* Simon 1864

38. **Cyrtophora cicatrosa** (Stoliczka) 1869.
Epeira (Nephila) cicatrosa Stoliczka 1869. *J. Asiat. Soc. Bengal* **38** : 242, fig. 5.
Distribution : India : Chingleput, Allahabad, West Bengal, Mysore, Maharashtra, Punjab ; Burma ; New Guinea.
Type : ZSI.

39. **Cyrtophora citricola** (Forskål) 1775.
Aranea citricola Forskål 1775. *Descript. Anima.*, p. 86.
Distribution : India : Bangalore, Poona, Punjab, Madhya Pradesh, Assam, West Bengal, Rajasthan ; Burma ; Ceylon ; Australia ; Madagascar ; Africa; Europe and Egypt.
Type : ?

40. **Cyrtophora feae** (Thorell) 1887.

Araneus feae Thorell 1887. *Ann. Mus. Genova* **25** : 173.

Distribution : India : West Bengal ; Burma.

Type : BMNH.

41. **Cyrtophora moluccensis** (Doleschall) 1857.

Epeira moluccensis Dol. 1857. *Nat. Tijdschr. Nederland* **13** : 418.

Distribution : India : Trivandrum, Nilgiri Hills, Madhya Pradesh, Darjeeling, Kalimpong, Sikkim ; Ceylon ; Burma.

Type : ?

Genus *GASTERACANTHA* Sundevall 1833

42. **Gasteracantha arcuata** (Fabricius) 1793.

Aranea arcuata Fab. 1793. *Ent. Syst.* **2** : 425.

Distribution : India : Assam, Sibsagar, West Bengal, Darjeeling, Sikkim ; Burma and Malaysia.

Type : ?

43. **Gasteracantha brevispina** (Doleschall) 1857.

Plectana brevispina Dol. 1857. *Nat. Tijdschr. Nederland* **13** : 423.

Distribution : India : Maharashtra, Orissa, Bihar, West Bengal, Andaman and Nicobar Islands ; Ceylon ; Burma ; Austro-Malaysia and Japan.

Type : ?

44. **Gasteracantha leucomelaena** (Doleschall) 1859.

Plectana leucomelaena Dol. 1859. *Verh. Nat. Vereen. Nederland* **5** (5) : 42, fig. 8.

Distribution : India : Orissa, Bihar, West Bengal, Nicobar Islands, Assam ; Bhutan ; Burma ; Malaysia and Japan.

Type : ?

45. **Gasteracantha dalyi** Pocock 1900. FAUNA BRIT. INDIA *Arachnida*, p. 232.

Distribution : India : Shevaroy Hills, south India.

Type : BMNH.

46. **Gasteracantha diadesmia** Thorell 1887. *Ann. Mus. Genova* **25** : 225.

Distribution : India : Andaman and Nicobar Islands ; Burma.

Type : BMNH.

47. **Gasteracantha geminata** (Fabricius) 1798.
Aranea geminata Fab. 1798. *Suppl. Ent. Syst.*, p. 292.
Distribution : India : Kerala, Mysore ; Ceylon.
Type : ?

48. **Gasteracantha hasseltii** Koch 1838. *Arach.* **4** : 29, fig. 267.
Distribution : India : Kerala, Orissa, Madras, West Bengal, Assam, Sikkim ; Burma.
Type : ?

49. **Gasteracantha remifera** Butler 1873. *Tr. Ent. Soc.*, p. 154, fig. 5.
Distribution : India : Andaman and Nicobar Islands ; Ceylon.
Type : ?

50. **Gasteracantha sororna** Butler 1873. *Tr. Ent. Soc.*, p. 155, fig. 15.
Distribution : India : Madras.
Type : ?

51. **Gasteracantha unguifera** Simon 1889. *J. Asia. Soc. Bengal* **58** : 336.
Distribution : India : West Bengal, Darjeeling, Kalimpong, Sikkim.
Type : MNHN.

Genus *HERENNIA* Thorell 1877

52. **Herennia ornatissima** (Doleschall) 1859.
Epeira ornatissima Dol. 1859. *Verh. Nat. Vereen. Nederland* **5** (5) : 32.
Distribution : India : Assam, West Bengal, Madras, Madhya Pradesh, Maharashtra, Kerala ; Ceylon ; Burma.
Type : ?

Genus *LEUCAUGE* White 1841

53. **Leucauge bengalensis** Gravely 1921. *Rec. Indian Mus.* **22** : 455, fig. 8g, h.
Distribution : India : Calcutta, Hooghly and 24 Parganas.
Type : ZSI.

54. **Leucauge celebesiana** (Walcknaer) 1837.
Tetragnatha celebesiana Walck. 1837. *Ins. Apt.* **2** : 222.
Distribution : India : Ootacamund, Poona, Calcutta, Darjeeling, Kalimpong, Gopaldhara, Shillong, Assam ; Ceylon ; Burma ; Celebes.
Type : ?

55. **Leucauge culta** (Cambridge) 1869.

Tetragnatha culta Cambridge 1869. *Proc. Linn. Soc.* London **10** : 390, figs. 69-75.

Distribution : India : Darjeeling Dist.; Ceylon.

Type : BMNH.

56. **Leucauge decorata** (Blackwall) 1864.

Tetragnatha decorata Blackwall 1864. *Ann. Mag. Nat. Hist.* **14** (3) : 44.

Distribution : India : Bangalore, Mysore, Coonoor, Nilgiri Hills, Madras, Barkul, Dehra Dun, Katihar, Siripur, Darjeeling, Calcutta ; Ceylon.

Type : BMNH.

57. **Leucauge tessellata** (Thorell) 1887.

Argyroepeira tessellata Thorell 1887. *Ann. Mus. Genova* **25** : 135.

Distribution : India : Cochin, Gopaldhara, Kalimpong, Assam. Sikkim ; Bhutan ; Burma.

Type : BMNH.

58. **Leucauge ventralis** (Thorell) 1877.

Meta ventralis Thorell 1877. *Ann. Mus. Genova* **10** : 423.

Distribution : India : Cochin, Calcutta ; Ceylon.

Type : BMNH.

Genus *NEPHILA* Leach 1815

59. **Nephila clavata** Koch 1877. *Verh. z.b. Ges. Wien* **27** : 741.

Distribution : India : Darjeeling, Kalimpong, Laccadive Islands, Andaman Islands, Shillong, Assam ; Sikkim ; Bhutan ; Burma and Japan.

Type : ?

60. **Nephila kuhlii** Doleschall 1859. *Verh. Nat. Vereen. Nederland* **5** (5) : 27, fig. 7.

Distribution : India : West Bengal ; Burma.

Type : ?

61. **Nephila maculata** (Fabr.) 1793.

Aranea maculata Fabr. 1793. *Ent. Syst.* **2** : 425.

Distribution : India : West Bengal, Madhya Pradesh, Bihar, Orissa, Andaman Islands, Maharashtra, Mysore, Kerala, Madras ; Bhutan ; Burma ; Ceylon ; China ; Japan.

Type : ?

62. **Nephila malabarensis** (Walck.) 1837.
Epeira malabarensis Walck. 1837. *Ins. Apt.* **2** : 103.
Distribution : India : Bombay, Bihar, Nicobar Islands, Kerala State; Burma; Ceylon; Thailand; Java; New Guinea; Australia.
Type : ?

63. **Nephila robusta** Tikader 1962. *J. Linn. Soc. London* **44** : 566.
Distribution : India : Goberdanga near Calcutta.
Type : ZSI.

Genus *ORDGARIUS* Keyserling 1886

64. **Ordgarius hobsoni** (Cambridge) 1877.
Cyrtarachne hobsoni Cambridge 1877. *Proc. Zool. Soc. London,* p. 562, fig. 3.
Distribution : India : Bombay, Poona Maharashtra; Ceylon; Japan.
Type : BMNH.

Genus *ORSINOME* Thorell 1890

65. **Orsinome armata** Pocock 1901. *J. Bombay nat. Hist. Soc.* **13** : 480.
Distribution : India: Shillong, Assam.
Type : BMNH.

66. **Orsinome marmorea** Pocock 1901. *J. Bombay nat. Hist. Soc.* **13** : 479.
Distribution: India : Ootacamund, Travancore.
Type : BMNH.

Genus *PASILOBUS* Simon 1895

67. **Pasilobus kotigeharus** Tikader 1962. *Proc. Indian Acad. Sci.* **57** : 96, fig. 1.
Distribution : India : Kotigehara, Chikmagalur Dist., Mysore.
Type : ZSI.

Genus *VENDILGARDIA* Simon 1895

68. **Vendilgardia assamensis** Louis 1924. *Rec. Indian Mus.* **26** ; 64, fig. 1a-e.
Distribution : India : Siju Cave, Garo Hills, Assam.
Type : ZSI.

(*to be continued*)

On a new Species of *Xenophthalmus* White, (Crustacea; Brachyura, Pinnotheridae) from Cochin[1]

BY

C. SANKARANKUTTY
Biological Oceanography Division, National Institute of Oceanography, Ernakulam-1

(*With a plate and six text-figures*)

The paper describes a new species of the genus *Xenophthalmus* White, *X. garthii* and compares it with the other two known species, *X. pinnotheroides* White and *X. obscurus* Henderson.

INTRODUCTION

The five specimens, on which the new species is based, were collected in 1965 and 1966 from Ponjikkara Island on the Cochin backwaters. Dr. John S. Garth of Allan Hancock Foundation, California, had collected a male of this species from the same locality in 1964 (Pers. comm.). The new species, unlike other members of the genus is an estuarine form. The salinity of its habitat varies considerably as a result of the monsoon. The observed range of salinity at the time of collection of these specimens was 13·08‰ to 29·75‰. The substratum at the place of collection consisted of silt and clay.

Xenophthalmus garthii sp. nov.

(Pl. I, Figs. 1-6)

Material: Holotype: a berried female; Reg. No. ZSI $\frac{C5979}{1}$; locality Ponjikkara Island (about 100 metres east of jetty), Cochin backwaters; collected on 17 November 1965. Allotype: Reg. No. ZSI

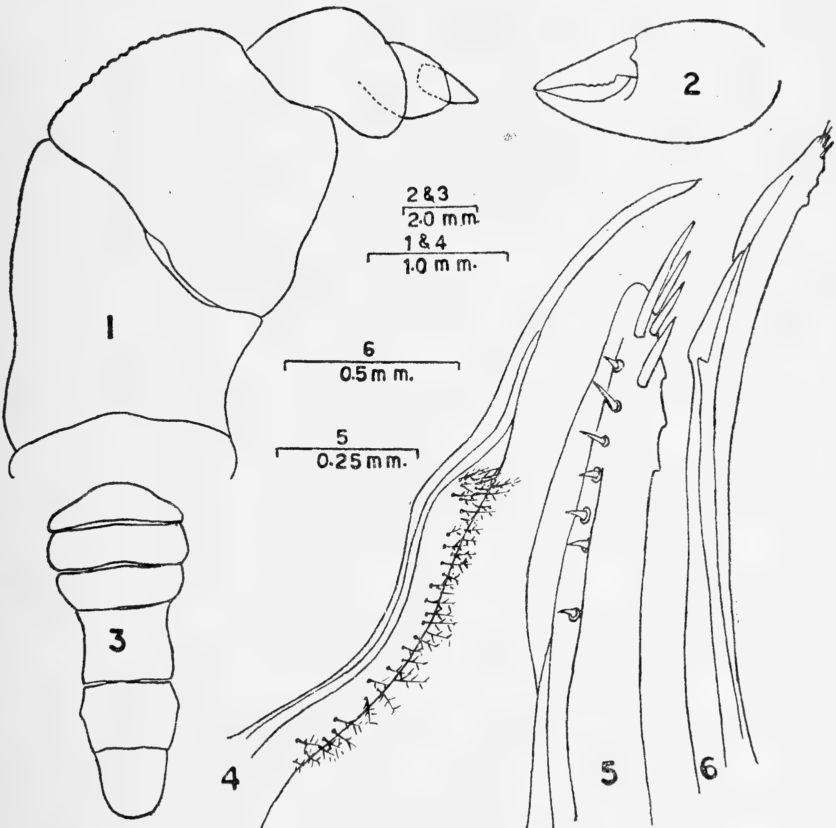
[1] Published with the kind permission of the Director, National Institute of Oceanography.

$\frac{\text{C5980}}{1}$; locality same as that of holotype; collected on 5 July 1966.

Paratypes: 3 females (one berried); Reg. No. ZSI $\frac{\text{C 5981}}{1}$; locality same as that of holotype; collected in November 1965.

The type specimens are deposited with the Zoological Survey of India.

Description: Carapace broader than long; flat across intestinal and branchial regions, prominently convex fore and aft and nearly flat laterally; smooth across intestinal and branchial regions, pitted in one specimen on the lateral margin of cardiac region, and across cardiac,



Figs. 1-6. *Xenophthalmus garthii* sp. nov. 1. External maxilliped. 2. Male chela. 3. Male abdomen. 4, 5 & 6. First male pleopod.

urogastric and branchial regions in others; granulated prominently as a triangular patch close to lateral margin in the branchial region in one, granulation feeble or nearly absent in others; minutely pubescent in the anterior half, pubescent and minutely granulated in the pterygostomian region; pubescence in male more conspicuous; an oblique ridge, fairly well recognisable in some or nearly absent in others, starting from the tip of the orbit and joining the first cleft of the lateral margin of carapace; another ridge on the anterior border of urogastric region curving backwards along its antero-lateral border then traversing across and terminating on an elevated granule a little away from the lateral margin; a conspicuous dot-like depression just anterior to this ridge midway between outer margin of gastric region and lateral margin of carapace; in one specimen the transverse ridge is replaced by a pair of short oblique ridges on the posterior border of cardiac region with an additional outer pair located slightly in advance of the inner pair; regions rather well marked, gastric region antero-laterally marked by depression, urogastric region demarcated as a depressed area, cardiac region marked laterally by deep furrows, in the holotype and allotype furrows demarcating cardiac and urogastric regions of nearly uniform thickness and in the form of deep 'H' with the anterior arms of 'H' slightly incurved; intestinal region delineated on the lateral sides by faint lines. Antero-lateral margins smoothly rounded, lateral margin granulated and with two clefts forming a small semi-circular lobe in between these clefts; a granulated tooth-like projection a little ahead of postero-lateral angle; posterior border broad, carinated throughout and concave in the middle; sub-branchial region puffed out visible dorsally beyond lateral margin and provided with an obliquely vertical faint granulated ridge.

Front not projecting to the extent of the anterior border of buccal cavern and standing on a higher plane than the hepatic region on either side; anterior border nearly straight and corners rounded, lateral borders almost straight. Orbit placed obliquely as a slit on the surface of carapace; tip narrow and pointing outwards; a small tooth at the base of the orbit and not touching the front on the inner side almost closing the orbit. Antenna standing at the opening of the orbit; peduncle of three segments, first thick and short, second longest and slender and third smallest; flagellum of about six segments, segmentation of flagellum indistinct in certain cases. External maxillipeds not completely closing the buccal cavern, its outer border uniformly rounded; exopod hidden by endopod and not reaching the distal end of merus, flagellum thin and concealed; ischium with flattened lobe at its proximal end provided with feathery setae, longer ones distally; propodus also flattened and almost circular attached about the middle of carpus, its distal end fringed with feathery setae; dactylus short, thick and finger-like attached on the upper side a little away from the tip of propodus.

Chelipeds slender and shorter than walking legs in females; upper and lower margins of merus unarmed but provided with fringes of bristles; upper surface of carpus with two, and outer surface with a single longitudinal row of bristles; palm shorter than fingers, its upper surface with two longitudinal rows of bristles, outer more dorsal and smaller, inner longer and pointing inwards ; outer surface close to ventral border with a sharp carina carrying a fringe of bristles extending from the proximal end to the tip of fixed finger ; dactylus with three longitudinal fringes of bristles on the dorsal surface ; fixed finger with a fringe of bristles on the inner side of cutting edge. Chelipeds in male dissimilar and much larger than walking legs ; segments unarmed and smooth ; merus pubescent along anterior and posterior border and with a tuft of bristles at the distal end on the outer side. Carpus of smaller cheliped with three fringes of hairs—two upper and one lower of which inner upper row more conspicuous. Propodus in larger chela expanded, about as high as long on the upper surface and a little higher than the length of movable finger ; flattened laterally, broader near the tip and narrowing uniformly to the tip of finger. Chela bent inwards towards the tip forming an arch ; fingers pointed and meeting only at the middle leaving a wide gap at their base, the gap being wider in the larger chela ; movable finger with an enlarged tooth near the base on the cutting edge, more conspicuous on larger chela, and with two rows of bristles on the upper surface ; fixed finger with a single row on the inner side (in addition to the fringe borne on the carina).

Fourth leg thin and shortest, third longest and as stout as second and first, first shorter than second. Postero-ventral margin of merus of first three legs armed with a row of spines of uniform size; its upper border in first three legs uniformly granulated and pubescent in the first leg. Pubescence reduced in the second and absent in the third, and fairly well developed in the fourth. Posterior surface of carpus in the first leg with a fringe of bristles, and in the second and third with a patch of woolly hairs. Propodus of first leg twisted but normal in other legs; its dorsal surface of proximal end expanded laterally ; distal end progressively twisted and narrower, the movement of propodus oblique ; in the twisted position propodus having three rows of bristles anteriorly, lowermost being most prominent and posterior border with a single row in addition a short distal fringe. Dactylus flattened laterally, dagger-shaped and fringed with bristles, tip pointing upwards. Upper and lower borders of propodus and both borders of dagger-shaped dactylus of fourth leg also fringed with bristles.

Abdomen of seven separate segments. In the male first four segments broadest, third segment with convex borders, fourth segment narrowing distally, fifth segment with a constriction near the base and widening distally, sixth segment broadest a little proximal to the middle of the segment. End segment very nearly as long as broad and with convex tip.

First male pleopod sinuous in shape, enlarged at about the middle, inner margin and upper surface with a number of branched hairs, not extending beyond the enlarged part ; under high magnification four subterminal thick short setae on the inner side.

MEASUREMENTS IN MM.

	Holotype	Allotype	Paratypes		
Length of front	1·00	0·86	0·86	0·86	0·81
Width of front	2·11	2·00	2·10	1·86	1·71
Length of carapace (from base of orbit to posterior border)	9·00	9·14	9·00	9·00	8·14
Width of carapace (between projections at postero-lateral angles)	12·71	12·14	12·28	12·57	10·14
Length of propodus of first walking leg	2·00	—	2·14	2·14	1·85
Height of propodus of first walking leg	1·57	—	1·71	1·57	1·28

DISCUSSION

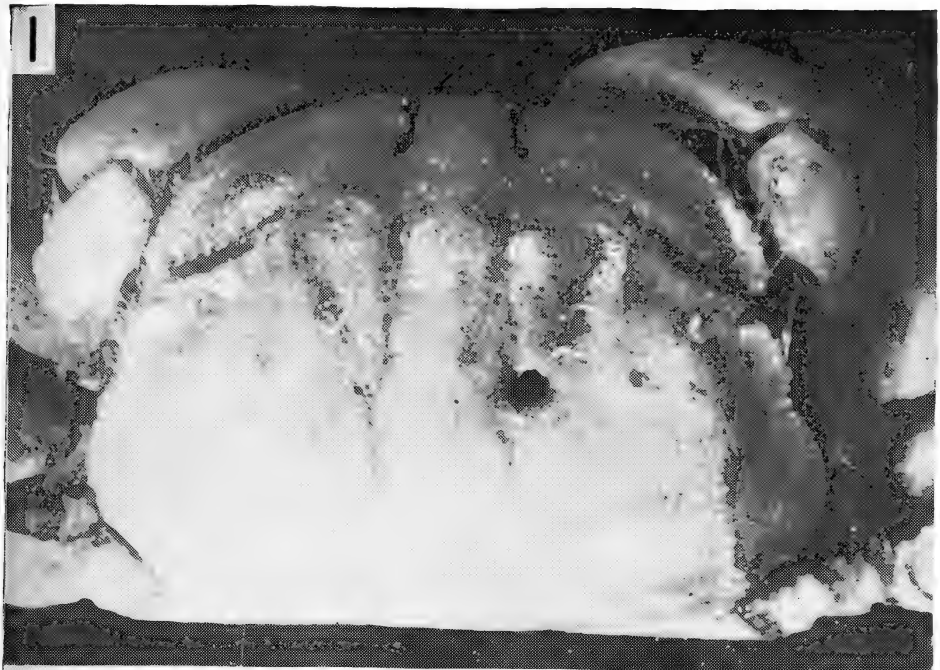
Xenophthalmus White is a rare genus containing three species, *X. pinnotheroides* White, *X. obscurus* Henderson and *X. garthii* sp. nov. *X. pinnotheroides* is found from the east coast of India (Henderson 1893 and Sankarankutty 1965) to Japan (Sakai 1955). *X. obscurus* is so far known only from the Indian Ocean (Alcock 1900).

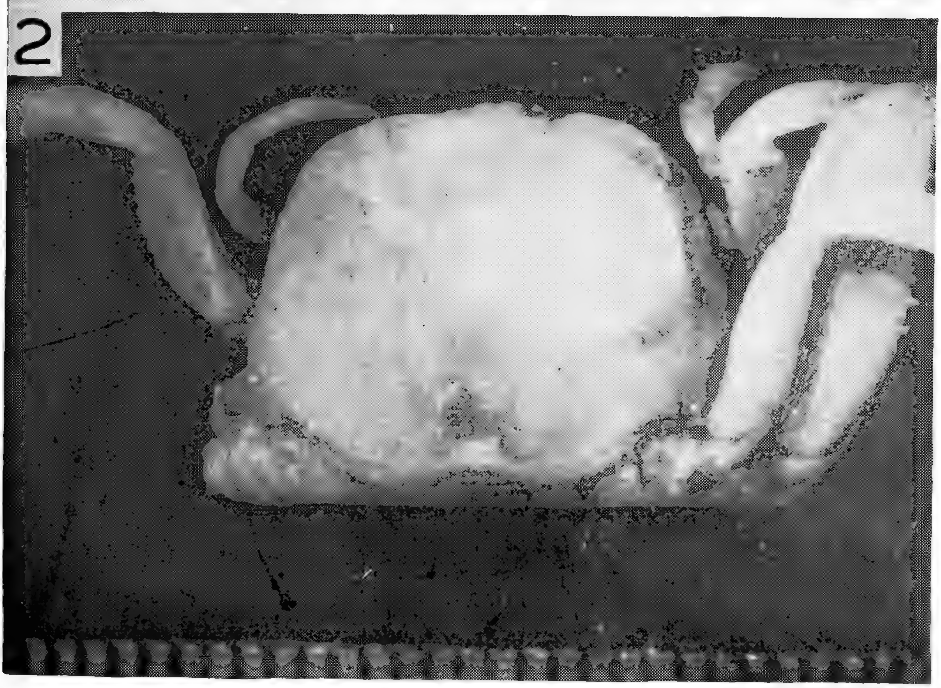
Affinities : *X. garthii* differs from *X. pinnotheroides* and *X. obscurus* in : (1) presence of two clefts on the lateral margin of carapace resulting in the formation of a small lobe in between and (2) presence of a small granulated projection a little ahead of postero-lateral angle of carapace.

It resembles *X. obscurus* in the oblique orbit and longer propodus of first leg. The following important differences were noticed on comparison with a female specimen of *X. obscurus* from the Indian Museum (No. 1025/7 ; Port Blair, Andamans) : (1) carapace almost devoid of pubescence ; (2) merus of external maxilliped narrowing prominently towards the distal end ; (3) branchial region minutely granulated ; and (4) armature on the ventral border of merus of walking legs (except on fourth) in the form of strong widely spaced curved hook-like spines, often with smaller ones in between.

Apart from the presence of lateral lobe of carapace, presence of projection on postero-lateral margin of carapace, oblique nature of orbit and longer propodus of first walking leg, it differs from *X. pinnotheroides*, in : (1) almost complete absence of pubescence on the longitudinal furrow of external maxilliped, (2) flattened and almost circular propodus of external maxilliped and, (3) uniform size of armature on the ventro-posterior border of merus of first three walking legs.

Dr. John S. Garth on comparing the male specimen with him (Allan Hancock Foundation) with the holotype of *X. obscurus* (female ;





1. *Xenophthalmus pinnotheroides* White. Male syntype, British Museum No. 43.6, locality Philippine Islands.
2. *X. obscurus* Henderson. Female holotype, British Museum No. 88.34, locality Martaban.

Martaban ; E. W. Gates Col. Reg. No. 88.34) and cotypes of *X. pinnotheroides* (A male and two females ; Philippine Islands ; H. Cuming Col. Reg. No. 43.6) in the British Museum noted the following additional differences (Pers. Comm.) : 'The Cochin specimen disagrees with *X. pinnotheroides* White, in having a short front, that of *pinnotheroides* being noticeably more advanced. The milled line extending from the orbit to the antero-lateral angle has no counterpart in *pinnotheroides*, but the lobe at the lateral angle is represented in *pinnotheroides* by a cluster of granules. There is no transverse dorsal ridge in *pinnotheroides* but its posterior border is long and straight like that of the Cochin specimen. Most remarkably, in *pinnotheroides* the carpus and propodus of the first walking legs are greatly broadened, giving this member a shovel-like appearance. In the Cochin specimen the hairs on the third walking legs are short and woolly, whereas on *pinnotheroides* they are long and silken. The external maxilliped has its propodus flattened in the Cochin specimen as you have noted ; in *pinnotheroides* it is deeply grooved but I did not see pubescence.

The Cochin specimen disagrees with *X. obscurus* Henderson in having a less advanced front. The ridge across the carapace bends forward in the Cochin specimen to pass forward of the cardiac region, while in *obscurus* it bends backward to pass behind the cardiac region. Also, while in the Cochin specimen the posterior margin is straight for the full width of the carapace, in *obscurus* it bends forward laterally above the coxa of the fourth walking legs. The propodus of the external maxilliped is broader anteriorly in Cochin specimen but not deeply grooved in either. The armature of the posterior border of the merus of the walking leg is spinulous in *obscurus*.

I did not examine pleopods because *X. obscurus* is represented only by the female and the types of *X. pinnotheroides*, while in good condition, have been relaxed from the dried collection. There is, however, a good difference in the shape of the male abdomen, that of Cochin specimen having both the broadest somite and next distal to it laterally rounded, while in *pinnotheroides* only the broadest (3rd ?) is rounded, the next distal having the margins straight and converging.

Only in *pinnotheroides* are the orbits true ' button-holes ' (closed both top and bottom).'

KEY TO THE IDENTIFICATION OF THE SPECIES OF *Xenophthalmus*

1.	Lateral margin of carapace with two clefts forming a lobe in between ; presence of a small tooth-like projection a little ahead of the postero-lateral angle of carapace ..	*X. garthii*
	Lateral margin of carapace with a single cleft, no tooth-like projection at the postero-lateral angle of carapace ..	2
2.	Orbits almost parallel to each other ; propodus of first walking leg as long as broad	*X. pinnotheroides*
	Orbits oblique ; propodus of walking leg longer than broad	*X. obscurus*

ACKNOWLEDGEMENTS

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Body weight, sex and age factors in a population of the Northern Palm Squirrel, *Funambulus pennanti* Wroughton

BY

ISHWAR PRAKASH AND L. R. KAMETKAR,
Division of Animal Studies, Central Arid Zone Research Institute, Jodhpur

(*With six text-figures*)

This paper presents a study of the Northern Palm Squirrel, *Funambulus pennanti* Wroughton at Jodhpur in Western India. The study area was a garden. Traps were generally placed where they were likely to catch more squirrels instead of in a grid system. Their positions were noted by numbering the trees, near the bases of which they were placed. A total of 213 squirrels were captured, marked and released for further observations. Marking was done by toe and ear clipping. Observations were made on body weight, sex ratio, age structure, and persistence.

INTRODUCTION

The palm squirrels of the genus *Funambulus* are familiar rodents living in association with man. They are arboreal, diurnal, and comparatively easy to trap. However, not much information is available on the population structure of this rodent. This paper gives data on the body weight, sex composition, age structure and variations in the squirrel population of a localised habitat at Jodhpur. Persistence of marked squirrels in the study area is also discussed.

STUDY AREA

Jodhpur has four distinct seasons : Winter (December to February), Summer (March to June), Monsoon (July to September) and Post-monsoon (October and November). The mean maximum temperature at Jodhpur is 25·9°C and the mean minimum 10·4°C during Winter, 37·9°C and 23·1°C in Summer, 34·6°C and 23·3°C during Monsoon ; and 33·1°C and 15·8°C during Post-monsoon respectively. The rainfall is almost confined to the monsoon season with a few showers occurring during winter. The average annual rainfall is 366 mm. There was scanty rainfall (178·6 mm.) during 1963 and drought conditions prevailed from September, 1963 to June, 1964. The rainfall recorded during 1964 was 539·3 mm.

The local habitat was a small garden, 1·16 hectare in area. There were 36 trees in this area belonging to the species : *Azadirachta indica* A. Juss.; *Phoenix sylvestris* Roxb.; *Ficus religiosa* Linn.; *Mangifera indica* Linn. ; *Albizzia lebbek* Benth. ; *Saraca indica* Linn. etc. Hedges of *Dodonea viscosa* Linn., *Tecoma stans* (Linn.) H.B.K., and shrub species like *Jasminum sambac* Ait., *Jasminum auriculatum* Vahl., *Hibiscus rosa-sinensis* Linn. and *Bougainvillea spectabilis* Willd. *Cynodon dactylon* Pers. was the dominant grass.

Methods

The study period was from April, 1963 to 15th November, 1964. The habitat was divided into three blocks and trapping was done with 15 traps on two days in a week in each block. However, only 12 traps were used during May and June, 1964. Since some traps always remained unoccupied, use of only 12 traps during these months did not affect the trapping. As the squirrel is arboreal, traps were placed near the base of the trees which were numbered. Placing the traps in a grid system over the area would have resulted in the capture of very few squirrels due to continuous disturbance from stray dogs and by personnel working in the area.

The squirrels caught were sexed, weighed and marked by toe clipping (Layne 1954). Squirrels up to number 198 were marked by this method and the rest with a combination of toe and ear clipping as it was felt undesirable to cut more than two toes from the foot. Marked squirrels were again released. The capture points were noted for the study of home ranges. Ten female squirrels, suspected to be pregnant, were retained in the laboratory during the course of the study for investigating litter size and post-natal development. Out of these ten, two died and three delivered. All the surviving animals that were retained in the laboratory were subsequently released.

Observations and Discussion

Body weight

During the period December, 1963 to March, 1964, new squirrels were not captured and, therefore, body weights of new squirrels could not be taken during these months. The individual weights of the squirrels handled varied from 28·0 to 129·0 gm. (Figs. 1 and 2). Mean monthly body weights and number of freshly captured squirrels weighed in every month are given in Table 1. The differences in mean body weight of male and female squirrels are not significant. However, the body

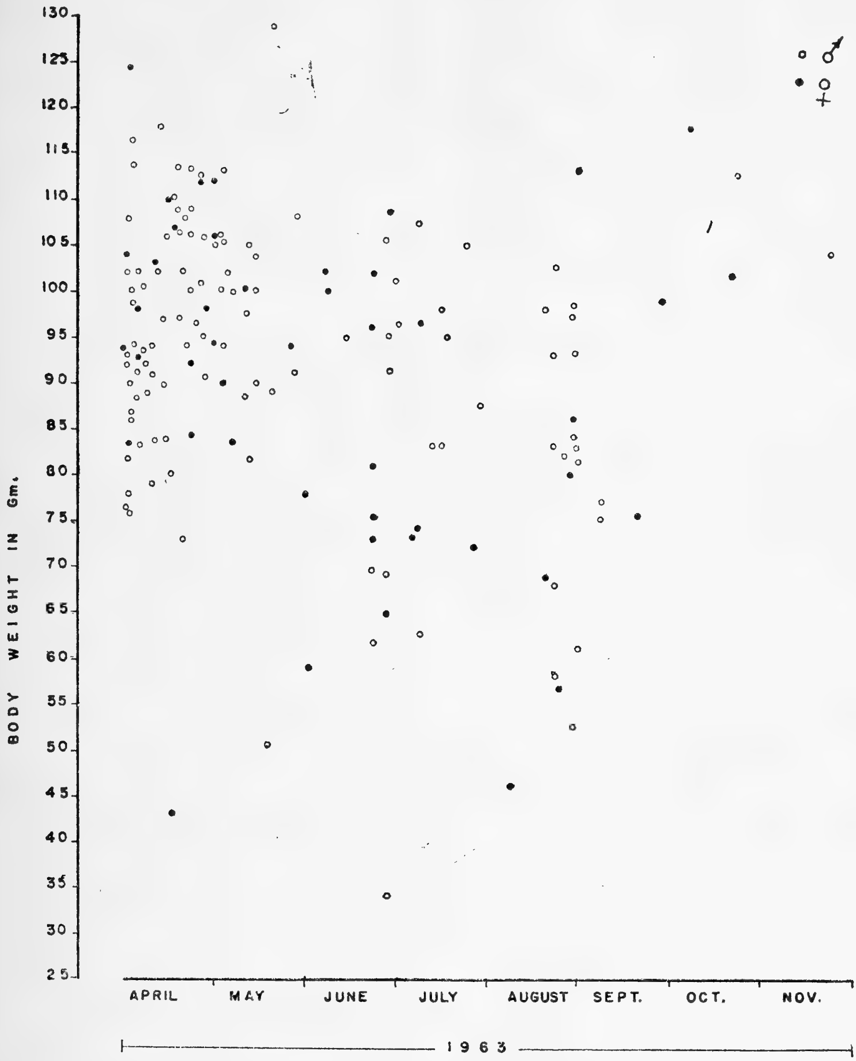

FIG. 1. Body weights of freshly captured squirrels during April to November, 1963.

weight is higher in April and May, 1963, as compared to other months. There is a gradual decrease in the body weight after these months. The weight again increases in October. Almost a similar trend was observed in the 1964 population, particularly among males. The decrease during June, July and August may be due to the presence of younger rodents in the population as this period is the main breeding season (Purohit, Kametkar & Prakash 1966) and, therefore, weight differences between individuals are high (Figs. 1 and 2).

TABLE 1

MEAN MONTHLY BODY WEIGHTS WITH STANDARD ERROR (SE) AND NUMBER OF FRESHLY CAPTURED SQUIRRELS

Months	Male		Female	
	No. weighed	Mean body weight (gm.) ± SE	No. weighed	Mean body weight (gm.) ± SE
1963				
April	51	96·08±1·8	13	96.44±4.29
May	18	98·0 ±3·69	5	91·20±2·82
June	8	77·28±8·42	11	85·45±5·09
July	11	89·77±4·34	4	78·87±5·89
August	15	82·32±4·32	6	75·0 ±9·39
September	2	76·0 ±1·0	2	77·25±1·73
October	1	112·5	2	109·75±8·72
November	1	104·0	—	—
1964				
April	8	96·12±0·30	3	93·3 ±2·76
May	8	71·25±11·1	4	89·25±24·38
June	8	73·93±7·46	5	76·40±10·34
July	8	77·0 ±11·49	1	103·5
August	4	60.0 ±9·49	3	77·33±7·61
September	2	87·5 ±2·55	—	—
October	2	92·0 ±9·37	2	71·5 ±21·36
November	0		0	

To examine these differences, squirrel weights were grouped at 20 gm. intervals. The 30·1-70 gm. classes correspond to sub-adults (Purohit 1963) and the rest to adults (Table 2). The sub-adult animals (5·5%) were observed in April among females of 1963 and in May among males (5·5%). In this year the population of the 30·1 to 50·0 gm. weight class rodents is low. During 1964, when drought conditions prevailed, the sub-adult classes appeared in the population in both sexes in May, a month later than the females of 1963. This may be an indication that breeding was delayed by one month in 1964. The second noteworthy point is the larger representation of 30·1 to 50 gm. weight class among the 1964 population (Table 2), particularly among males, which shows that the emergence of young squirrels, and their weights at emergence differed during years. During 1964, the mother squirrels were not probably in a position to continue providing sufficient milk for their litter as they were in poor condition after the prolonged heat stress although there was enough water and vegetation. Therefore, relatively younger (and lighter) individuals were forced to venture out of their nests in quest of food. A very young squirrel weighing 28 gm. was captured in July, 1964.

TABLE 2

MONTHLY DISTRIBUTION OF VARIOUS WEIGHT CLASSES OF PALM SQUIRRELS EXPRESSED AS PER CENT OF MONTHLY COLLECTION OF BOTH SEXES

Weight class gms.	1963								1964						
	April	May	June	July	Aug.	Sept.	Oct.	Nov.	April	May	June	July	Aug.	Sept.	Oct.
Male population															
30·1-50·0 ..	00	00	12·5	00	00	00	00	00	00	43	12·5	14·3*	25	00	00
50·1-70·0 ..	00	5·5	37·5	18·1	26·6	00	00	00	00	00	37·5	28·5	25	00	00
70·1-90·0 ..	26	16.6	00	27·2	33·3	100	00	00	25	00	12·5	00	50	100	50
90·1-110·0 ..	66	66·6	50·0	54·6	40·0	00	00	100	75	57	37·5	28·5	00	00	50
110·1-130·0 ..	8	11	00	00	00	00	100	00	00	00	00	28·5	00	00	00
Female population															
30·1-50·0 ..	5·5	00	00	00	16·6	00	00	00	00	25	00	00	00	00	00
50·1-70·0 ..	00	00	18·1	00	33·3	00	00	00	00	00	60	00	33·3	00	50
70·1-90·0 ..	16·6	60	36·3	75	33·3	50	00	00	66·6	00	00	00	66·6	00	00
90·1-110·0 ..	61·1	40	45·4	25	00	50	50	00	00	25	40	100	00	00	50
110·1-130·0 ..	16·6	00	00	00	16·6	00	50	00	33·3	50	00	00	00	00	00

* One sub-adult squirrel weighed 28 gm.

A majority of the squirrel population falls in the 70·1 to 100·0 gm. class. A heavier weight class (110·1-130·0 gm.) was observed during 1963, in April and May in the males and in April only among the females.

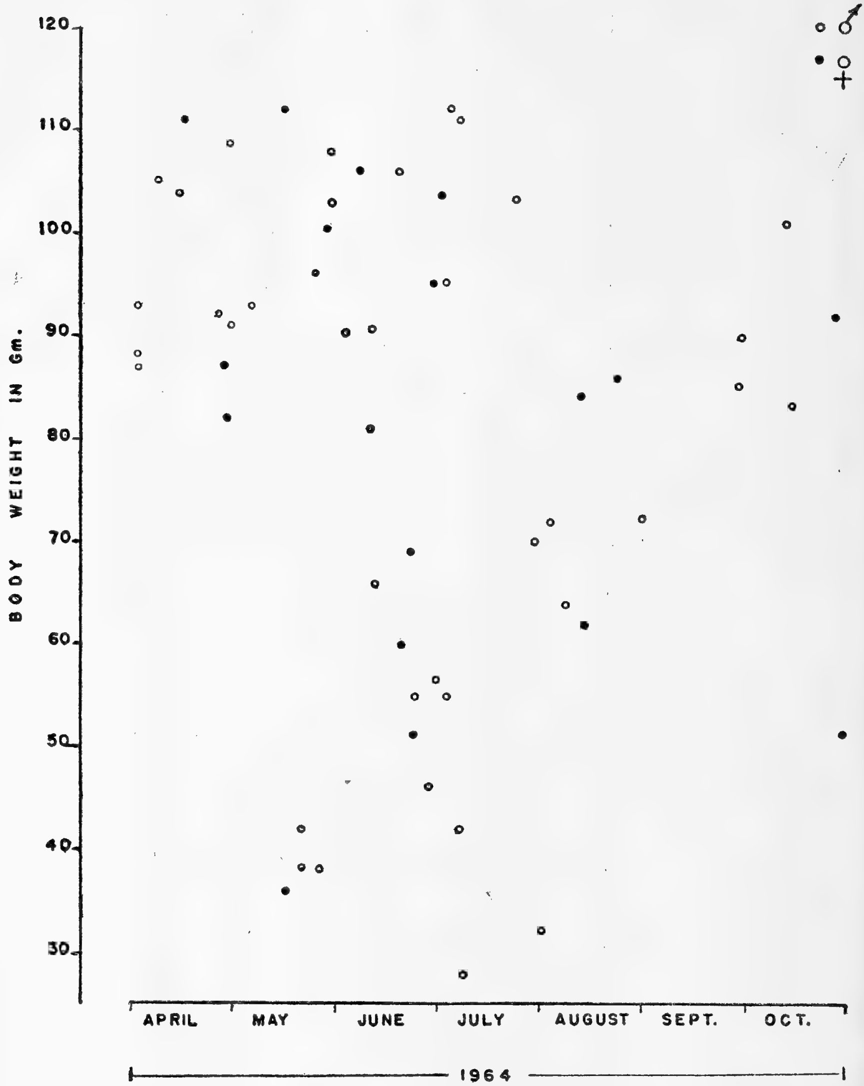

FIG. 2. Body weights of freshly captured squirrels during April to October, 1964.

In both sexes it reappeared in October but was also present in August in the females which might be due to the presence of pregnant females as breeding activity is maximum during the monsoon season. During 1964, however, this class occurred only in July in the male population and during April and May in female population but it was totally absent

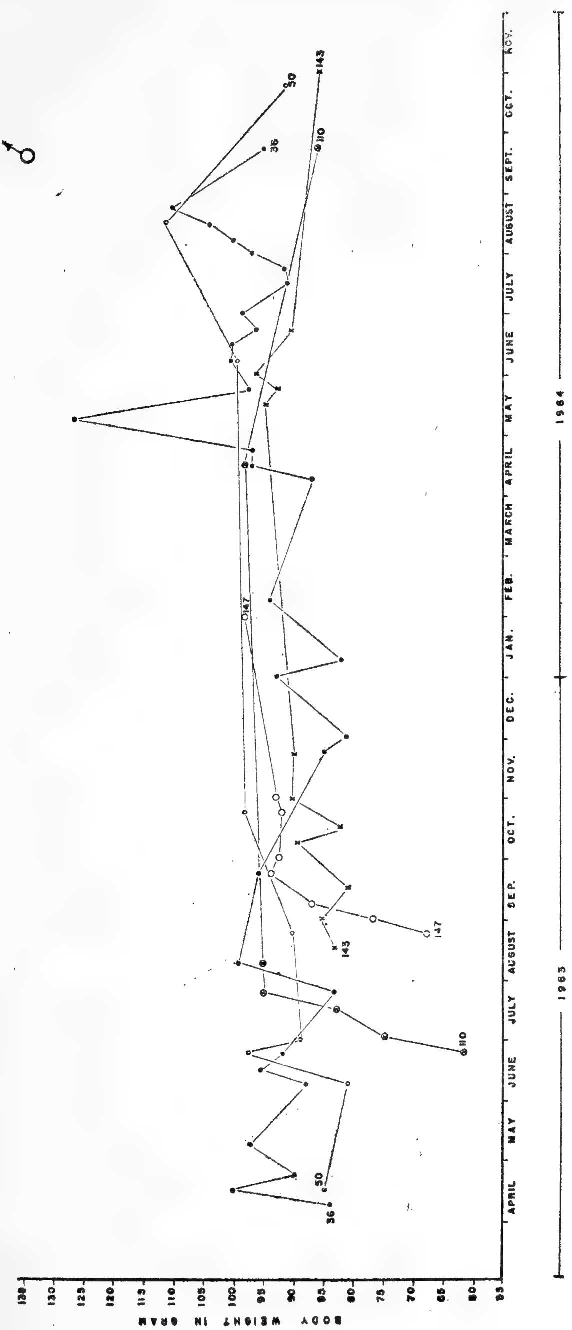

FIG. 3. Body weights of five male squirrels trapped repeatedly during the course of study.

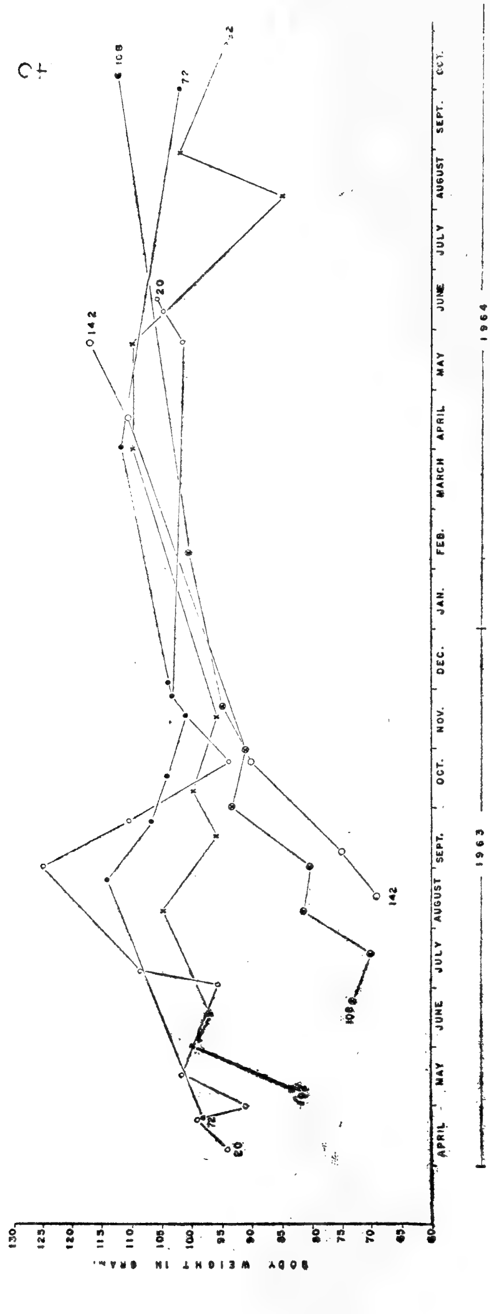

FIG. 4. Body weights of five female squirrels trapped repeatedly during the course of study.

in the latter months in the male population. This difference in the two seasons may be an indication that the old animals were either eliminated due to heat stress when living conditions were not very favourable or they migrated from this habitat.

Body weights of individual squirrels which were captured many times during the study period have been plotted (Figs. 3 and 4) to examine the seasonal fluctuations. It will be seen that in most of the males (Fig. 3) the body weights have peaks during monsoon in both the years. Squirrel No. 36, however, had a major peak in May, 1964. Males showed a general decline in body weight during the summer months and post-monsoon season although there are indications of higher monthly weights in the entire population during this period (Table 1). The females also showed peaks in body weight in the monsoon season during 1963 (Fig. 4). Unfortunately these squirrels did not visit the traps in the 1964 rainy season and it is difficult to compare the trend of their weights with that of 1963 although squirrel No. 92 showed a decrease in body weight in this season. These five females also showed a decline in body weight during summer 1963, such decline is also indicated by the body weight figures presented in Table 1.

Sex ratio

During the entire study 213 squirrels were collected, out of which 147 were males and 66 females which shows that there is a general preponderance [69%, significantly different from 50% ($\chi^2_{(1)}$ 30·8 $P < \cdot001$] of males in the population. The females were 57·9 and 66·0 per cent of the monthly captures during June and October, 1963, respectively (Table 3). These values are not significantly different from 50 per cent. During

TABLE 3

SEX RATIO OF SQUIRRELS CAPTURED DURING APRIL TO NOVEMBER, 1963 AND FROM APRIL TO OCTOBER, 1964

Months	1963			1964		
	Male	Female	% Male	Male	Female	% Male
April	51	18	73·9	8	3	72·7
May	18	5	78·2	8	4	66·6
June	8	11	42·1	8	5	61·5
July	11	4	73·3	8	1	88·8
August	15	6	71·4	4	3	57·1
September	2	2	50·0	2	0	—
October	1	2	33·3	2	2	50·0
November	1	0	—	—	—	—
	107	48	69·0	40	18	68·9

September, 1963 and October, 1964, both sexes were trapped in equal numbers. The sex ratios remained identical in the year 1963 (2·22 ♂♂ : 1 ♀) and 1964 (2·22 ♂♂ : 1 ♀).

The preponderance of males was also observed in sub-adult *Funambulus pennanti*. During 1963, 11 male and 6 female sub-adults were collected having a ratio of 1·83 ♂♂ : 1 ♀ but during 1964 this ratio was 2·33 ♂♂ : 1 ♀ (Table 4). A slightly greater number of males has been

TABLE 4

SEX RATIO OF SUB-ADULT SQUIRRELS DURING APRIL TO OCTOBER, 1963 AND 1964

Months	1963			1964		
	Male	Female	% Male	Male	Female	% Male
April	0	1	No Male collected	0	0	—
May	1	0	No female collected	4	1	80
June	4	2	66·6	4	3	57.1
July	2	0	No female collected	4	0	No female collected
August	4	3	57·1	2	1	66.6
September	0	0	—	0	0	—
October	0	0	—	0	0	—
	11	6	64·7	14	5	73·7

observed in the Red Squirrel, *Tamiasciurus hudsonicus locuax* in Central New York by Layne (1954) who found 102 males to 100 females in the overall population as compared to 227·7 males : 100 females in *F. pennanti*. Among the sub-adults, however, he recorded 188 males to 100 females as compared to 208·3 sub-adult males for 100 sub-adult females among palm squirrels. Among other species of North American squirrels, Allen (1942) noted a preponderance of females (66%) in the Fox Squirrel, *Sciurus niger rufiventer* at Michigan. Evans & Holdenried (1943) and Fitch (1948) also found greater number of females in the population of Beechy Ground Squirrel, *Citellus beecheyi* in California.

Age structure

In the absence of any work on age determination in the palm squirrel, the observations of Purohit (1963) were taken into account for classifying the squirrel population in two major groups—sub-adults and adults. Squirrels weighing above 70 gm. were found to be sexually active, hence in this paper, squirrels weighing 70 gm. or below are regarded to be sub-adults. The adult to sub-adult ratio in males of 1963 was 8·7 : 1 and of

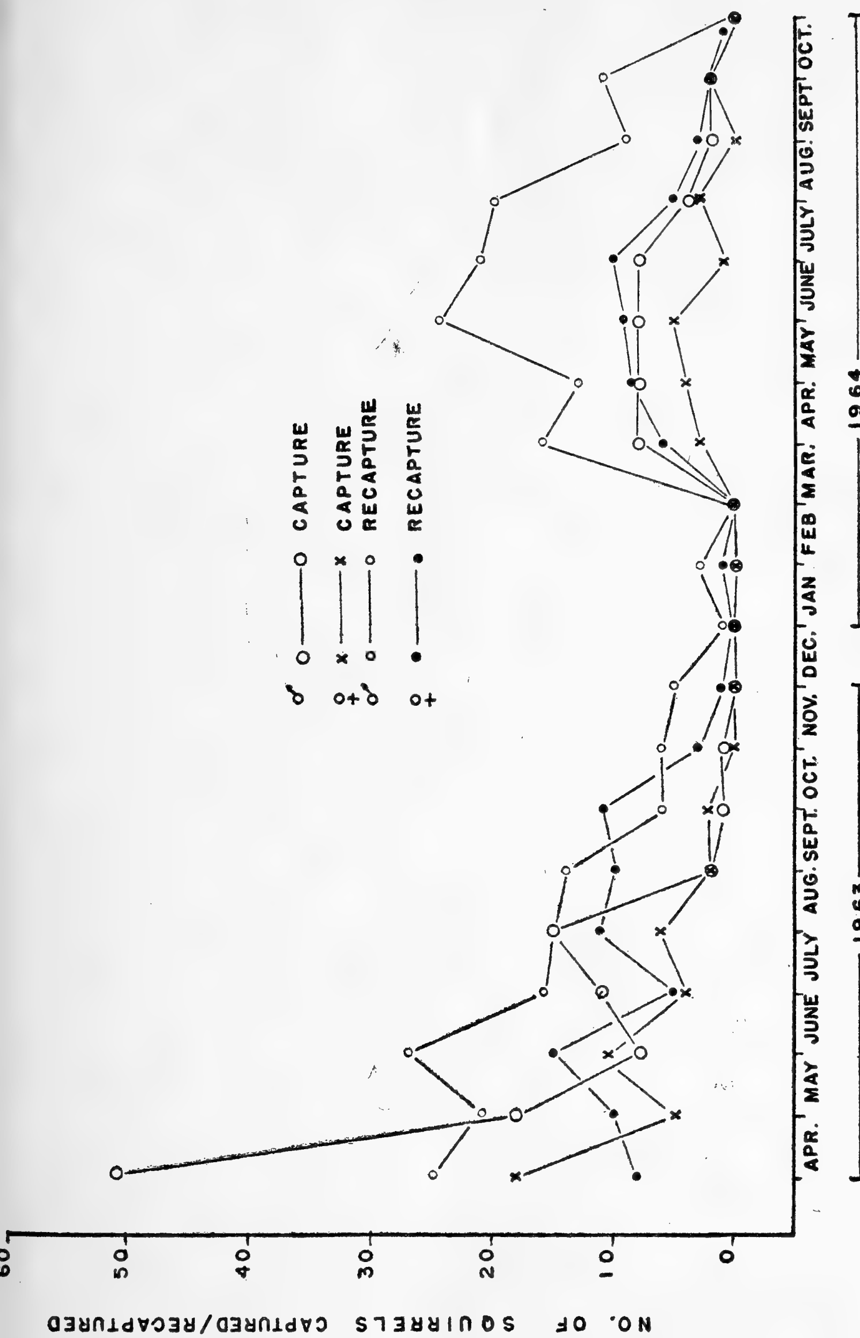

FIG. 5. The number of male and female squirrels captured and recaptured during the study.

adult females to sub-adult females 7 : 1 whereas this ratio showed a considerable change in the 1964 population and was 1·8 : 1 and 2 : 1 respectively. This shows that the number of adult squirrels were reduced to a very great extent in the 1964 population. The rainfall data show that the monsoon failed in 1963 and conditions of heat stress prevailed from September, 1963 to June, 1964. During this period the older generation of squirrels either perished or migrated out of the study area. Such variations in the squirrel numbers during two consecutive years have also been noticed by Allen (1942) in the Fox Squirrel *Sciurus niger rufiventer* at Michigan.

Trapping results

Capture : Figure 5 indicates that the maximum number of squirrels were collected in the first month of the study period after which a gradual decline (small peaks were noticed in June and August) in the captured rodents was observed till November, 1963. Subsequently, from December, 1963 to March, 1964, no new individual was captured. These capture results indicate that the squirrels were more attracted to the traps with bait in summer months as compared to winter months. An almost similar trend was observed from April to November, 1964, when the study came to an end in November due to shifting of the Institute to its own building. The absence of new captures during winter may also be due to the cold spell when squirrels are likely to become torpid.

Recapture: Table 5 (a) and (b) indicate that the percentages of females recaptured during the two years under study varied (79·1% in 1963 and

TABLE 5 (a)

NUMBER OF SQUIRRELS CAPTURED AND RECAPTURED DURING APRIL, 1963 TO OCTOBER, 1964 PERIOD

Year	Total marked			Total recaptured			Total not recaptured		
	♂	♀	♂♀	♂	♀	♂♀	♂	♀	♂♀
1963 ..	107	48	155	78	38	116	29	10	39
1964 ..	40	18	58	29	8	37	11	10	21
1963-64 ..	147	66	213	107	46	153	40	20	60

44·4% in 1964). The recapture percentages of males, however, were almost similar in both the years. The trap shyness of the marked female squirrels during the second year is difficult to explain.

The recapture rate was in conformity with the capture rate, being highest in summer and lowest in winter indicating that there was a seasonal variation in their behaviour towards traps. In winter months, moreover, unmarked and marked squirrels did not behave alike towards

TABLE 5 (b)

PERCENTAGE OF RECAPTURED SQUIRRELS DURING APRIL, 1963 TO OCTOBER, 1964 PERIOD

Year		Per cent recaptured		
		♂	♀	♂♀
1963	..	72·9	79·1	74·8
1964	..	72·5	44·4	63·7
1963-64	..	72·7	69·6	71·8

the traps when no fresh squirrels were trapped but marked ones which were familiar with them continued to visit the traps.

Variations in squirrel population: Results in Table 6 indicate that the number of squirrels trapped varied between months and between years. The peaks were, however, observed in April, June and August, 1963 and April, June and October, 1964.

TABLE 6

NUMBER OF SQUIRRELS IN THE STUDY AREA DURING VARIOUS MONTHS

Months		Number of squirrels trapped
1963		
April	..	102
May	..	54
June	..	61
July	..	36
August	..	47
September	..	28
October	..	30
November	..	10
December	..	6
1964		
January	..	1
February	..	4
March	..	No catch
April	..	33
May	..	33
June	..	46
July	..	60
August	..	32
September	..	18
October	..	17

Persistence of marked squirrels : Tables 7 and 8 present the number of retrapped squirrels according to the month of first capture and the last recapture. It is possible to calculate the number of squirrels persisting in the study area in any month if we assume that a squirrel remains continuously in the study area between its first and last capture regardless of the pattern of captures in between. It is logical that the squirrels captured for the last time disappear from the study area after the month of last capture. The rest—which have been recaptured in subsequent months—continue to persist in that month. These numbers are plotted as percentage of total number of retrapped squirrels in Figure 6 which

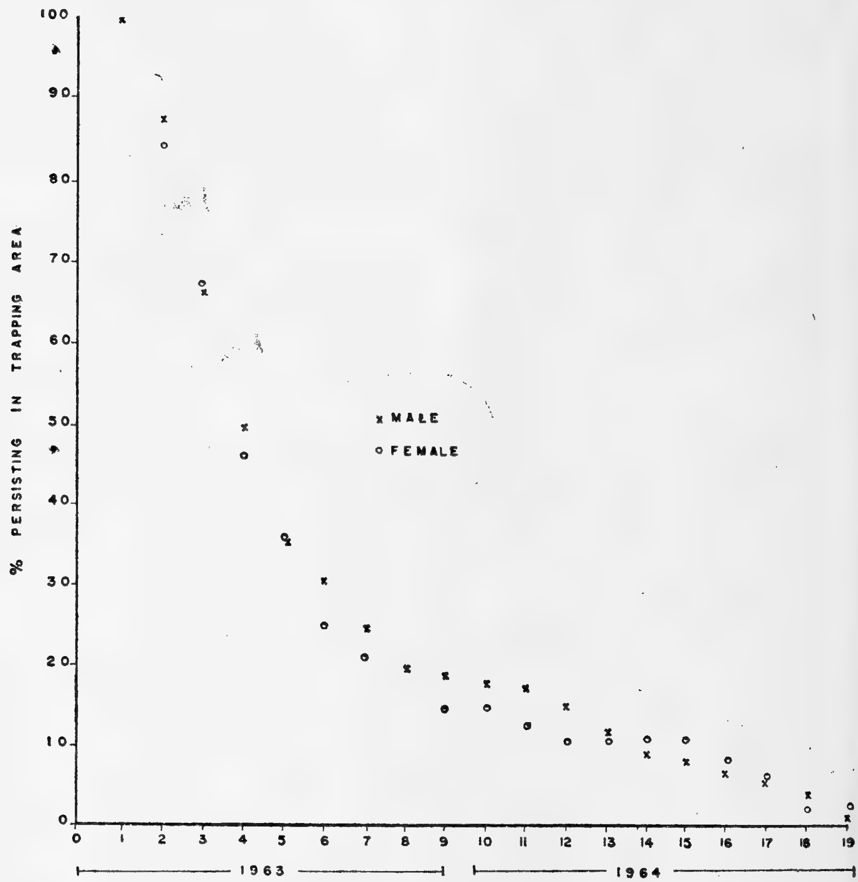

FIG. 6. Per cent marked male and female squirrels persisting in the study area since the month of first capture.

shows that persistence of both the sexes of squirrel dropped down rapidly up to the eighth month when only 19 per cent male as well as female *F. pennanti* persisted in the population. Thereafter the persistence reduced at a lower rate till the last month of the study period when only two

TABLE 7

INTERVAL BETWEEN FIRST CAPTURE AND LAST RECAPTURE OF MARKED FEMALE SQUIRRELS (IN THE COLUMN OF MONTHS OF FIRST CAPTURE, NUMBER OF SQUIRRELS WHICH WERE MARKED IN THAT MONTH AND RECAPTURED LATER ON, IS GIVEN IN PARENTHESIS)

Months of first capture		Months of last recapture 1963									1964										
		April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.
1963																					
April	(16)	2	3	4	—	1	1	1	2	—	—	—	—	—	—	1	—	—	—	1	—
May	(4)		1	—	—	1	—	1	—	—	—	—	—	—	—	—	—	—	1	—	—
June	(8)			3	—	1	1	1	—	—	—	—	—	—	—	—	—	—	1	1	—
July	(3)				—	—	—	1	2	—	—	—	—	—	—	—	—	—	—	—	—
Aug.	(4)					—	1	1	1	—	—	—	—	—	1	—	—	—	—	—	—
Sept.	(2)						—	—	1	—	—	—	—	—	—	—	1	—	—	—	—
Oct.	(1)							—	1	—	—	—	—	—	—	—	—	—	—	—	—
Nov.	(0)								—	—	—	—	—	—	—	—	—	—	—	—	—
Dec.	(0)									—	—	—	—	—	—	—	—	—	—	—	—
1964																					
Jan.	(0)										—	—	—	—	—	—	—	—	—	—	—
Feb.	(0)											—	—	—	—	—	—	—	—	—	—
March	(0)												—	—	—	—	—	—	—	—	—
April	(0)													—	—	—	—	—	—	—	—
May	(3)														—	—	2	—	1	—	—
June	(4)															—	2	2	—	—	—
July	(1)																—	1	—	—	—
Aug.	(0)																	—	—	—	—
Sept.	(0)																		—	—	—
Oct.	(0)																			—	—
Nov.	(0)																				—

TABLE 8

INTERVAL BETWEEN FIRST CAPTURE AND LAST RECAPTURE OF MARKED MALE SQUIRRELS (IN THE COLUMN OF MONTHS OF FIRST CAPTURE, NUMBERS OF SQUIRRELS WHICH WERE MARKED AND RECAPTURED LATER ON, IS GIVEN IN PARENTHESIS)

Months of first capture		Months of last recapture 1963									1964										
		April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.
1963																					
April	(40)	5	8	7	4	2	4	3	1	—	—	1	—	—	—	1	—	1	2	1	—
May	(13)		2	3	2	1	—	1	1	—	—	—	—	1	1	—	—	—	—	1	—
June	(7)			—	1	2	—	—	—	—	—	—	—	1	1	—	—	—	1	1	—
July	(4)				1	1	1	—	—	—	—	—	—	—	—	—	—	1	—	—	—
Aug.	(10)					1	1	1	1	2	—	1	—	—	—	—	1	1	—	1	—
Sept.	(2)						—	—	—	—	—	—	—	—	1	—	—	1	—	—	—
Oct.	(1)							—	—	1	—	—	—	—	—	—	—	—	—	—	—
Nov.	(1)								—	—	—	—	—	—	—	—	—	1	—	—	—
Dec.	(0)									—	—	—	—	—	—	—	—	—	—	—	—
1964																					
Jan.	(0)										—	—	—	—	—	—	—	—	—	—	—
Feb.	(0)											—	—	—	—	—	—	—	—	—	—
March	(0)												—	—	—	—	—	—	—	—	—
April	(6)													—	1	2	3	—	—	—	—
May	(6)														—	1	—	3	—	2	—
June	(8)															1	4	1	1	1	—
July	(5)																1	1	1	2	—
Aug.	(3)																	1	1	1	—
Sept.	(1)																		—	1	—
Oct.	(0)																			—	—
Nov.	(0)																				—

per cent marked female and one per cent male squirrels persisted in the study area.

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Some observations on the juveniles of *Hilsa ilisha* (Hamilton) (Pisces: Clupeidae) from Godavari Estuary

BY

M. Babu Rao

Zoology Department, Andhra University, Waltair[1]

(*With a map and two text-figures*)

Introduction

This paper is a brief account of the observations made on *Hilsa ilisha* in the lower reaches of Godavari estuary during the period 1958-1962. Observations were mainly made in the Gautami branch of the estuary (Fig. 1) and some of the aspects like length-weight relationship and biometric studies were restricted to juveniles. The aspects covered by Pillay & Rao (1963) were omitted.

Material and methods

When it is about 80 km. from the sea, the River Godavari divides into two branches—the eastern branch is the Gautami and the western branch divides further into two, the Vasishta and Vainateyam (Fig. 1). The Gautami Godavari, when about 10 km. from the sea, further splits into two branches, one branch joining the sea at Bhairavapalem and the other about 15 km. to the south, at Kothapalem.

Observations were made on fishermen's catches at five fish landing centres situated in the lower reaches of the Gautami (Fig. 1). The five fishing centres are: (i) Balusutippa, located about 8 km. from the Kothapalem or southern mouth of the Gautami, (ii) Bhairavapalem, located about 6 km. from the northern mouth of the Gautami, (iii) Neellapalli situated near the field station at Yanam (Fig. 1) about 20 km. from the Kothapalem and 16 km. from the Bhairavapalem, (iv) Masakapalli, located further up, about 35 km. from the mouth and (v) Kotipalli, which is 45 km. from the river mouth. Collections of juvenile *Hilsa* and observations on adult *Hilsa* were made every week from Neellapalli and once in a month in the other fish landing centres.

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[1] Present address: Zoological Survey of India, 8, Lindsay Street, Calcutta-16

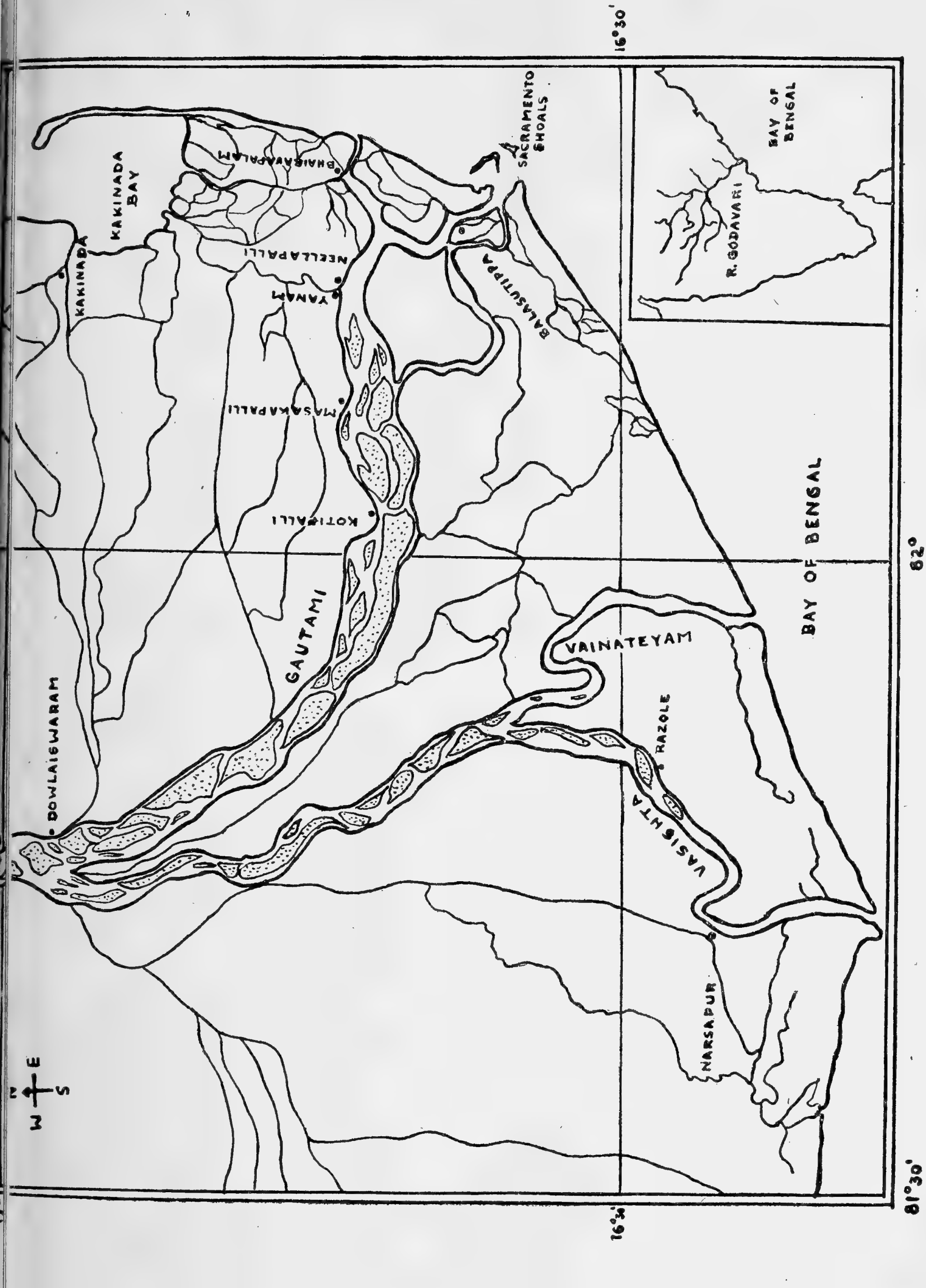

FIG. I. THE GODAVARI ESTUARY

Length-weight data were taken in fresh condition and morphometric and meristic characters were taken in preserved condition.

Observations on the *Hilsa* fishery in the lower reaches

The general pattern of *Hilsa* fishery in the lower reaches as observed in a stretch of about 45 km. from the river mouth to (Kotipalli) up the river, is as follows : the fishery begins with the upward migration of mature adults ranging from 25 cm. to 55 cm. in length. This migration which begins in July continues until October. This is a spawning migration, as most of them are in stages V and VI of maturity and since it is correlated with the south-west monsoon, it may be referred to as the monsoon spawning migration. Sometimes in November-December, there is a lull in the fishery, marking the end of the monsoon migration. This lull is followed by another wave of upward migration of adults extending from the latter part of December to March. These migrants are more or less of the same length as the monsoon migrants, i.e. 25-55 cm. ; they may be referred to as the post-monsoon migrants.

The downward migration of the spent adults of the monsoon migration extends from October to December as evidenced by the condition of the gonads, and that of the post-monsoon migrants from April to early June. The net employed for adult *Hilsa* is the drift net called ' Rangoon net ' which is laid across the river.

In addition to the adult *Hilsa* fishery from July to early June, which involves the capture of upward migrating maturing and mature adults as well as the downward migrating spent individuals, immature *Hilsa* are caught by smaller shore seines and bottom set gill nets. Most of the fishes from these catches range from 9 cm. to 15 cm. and only a few are bigger, from 16 cm. to 19 cm. The fishery for these immature forms extends from January to June with a peak period from February to April. During the four seasons (1958-'59, 1959-'60, 1960-'61 and 1961-'62), the majority of the immature *Hilsa* caught right from January to May ranged between 10 cm. and 13 cm., indicating an extended spawning season. The general absence of juveniles below 8 cm., in the catches, can be attributed to the fact that the gill nets are very selective and also it might be that they avoid the small shore seines which do not cover the middle of the river.

Detailed account of the observations made on the migrations during the three seasons, 1959-'60, 1960-'61 and 1961-'62, is as follows :

In the 1959-'60 season the monsoon migration of the maturing adults began in July and extended till October 1959. The post-monsoon phase of the migration started in December 1959 and extended up to May 1960. The juveniles started to appear from the end of January 1960 and were in the estuary till June.

In the 1960-'61 season the monsoon migration of the adults started in July and extended to the beginning of December 1960. The post-monsoon migration of adults extended from January to April 1961. The juveniles appeared in February and extended up to July 1961.

In the 1961-'62 season, the monsoon migration of the adults started in August and extended up to the beginning of October 1961. The post-monsoon migration started towards the end of November 1961 and continued till April 1962. During this season, the post-monsoon migration period was long and accounted for an extensive fishery. The juveniles started to appear in small numbers from January 1962 till April, and then in larger numbers till the end of May 1962.

A survey made in the other two branches of the Godavari—Vainateyam and Vasishta—during the 1961 season, has shown a similar pattern except that the fishery is not so extensive as in the Gautami, which is much larger.

The two waves of migrations of adult *Hilsa* in the Godavari are similar to those observed in the Hooghly River (Pillay 1958) and Chilka Lake (Jones & Sujansingani 1951).

Length frequency

Monthly percentage length frequency curves for the juvenile *Hilsa*, purchased from the fishlanding centres were prepared for the years 1959, 1960, 1961 and 1962 (Fig. 2). In the commercial catches specimens of length 5 cm. to 19 cm. were obtained during these years and the general period of occurrence was from January to July. The occurrence of more or less the same length group in different months indicate that the spawning season is somewhat extended.

Length-weight data and morphometric and meristic data were obtained from these samples.

Length-Weight relationship

Length-weight data were obtained for the juveniles of all the four years. Of the four years, specimens obtained in 1960 were distributed in a wider length range, 6 cm. to 19 cm. in total length. Hence various regression equations have been tried on the data of this year to establish the type of equation that expresses the length-weight relationship of this species from Godavari estuary. Averages of lengths and weights were obtained for each 0·5 cm. length group and a scatter diagram was plotted. Various equations expressing different curvilinear regressions have been tried to the data (Fig. 3). The equation $W=a+b.\ L^3$ is found to give the best results, as is evident from comparison of the sum of squared differences of the observed and calculated weights (Table 1). The equations obtained for the juveniles of the four years are presented in

Table 2. For Hooghly *Hilsa*, Pillay (1958) has given $W = Ae^{b.L}$ as the best for length-weight data.

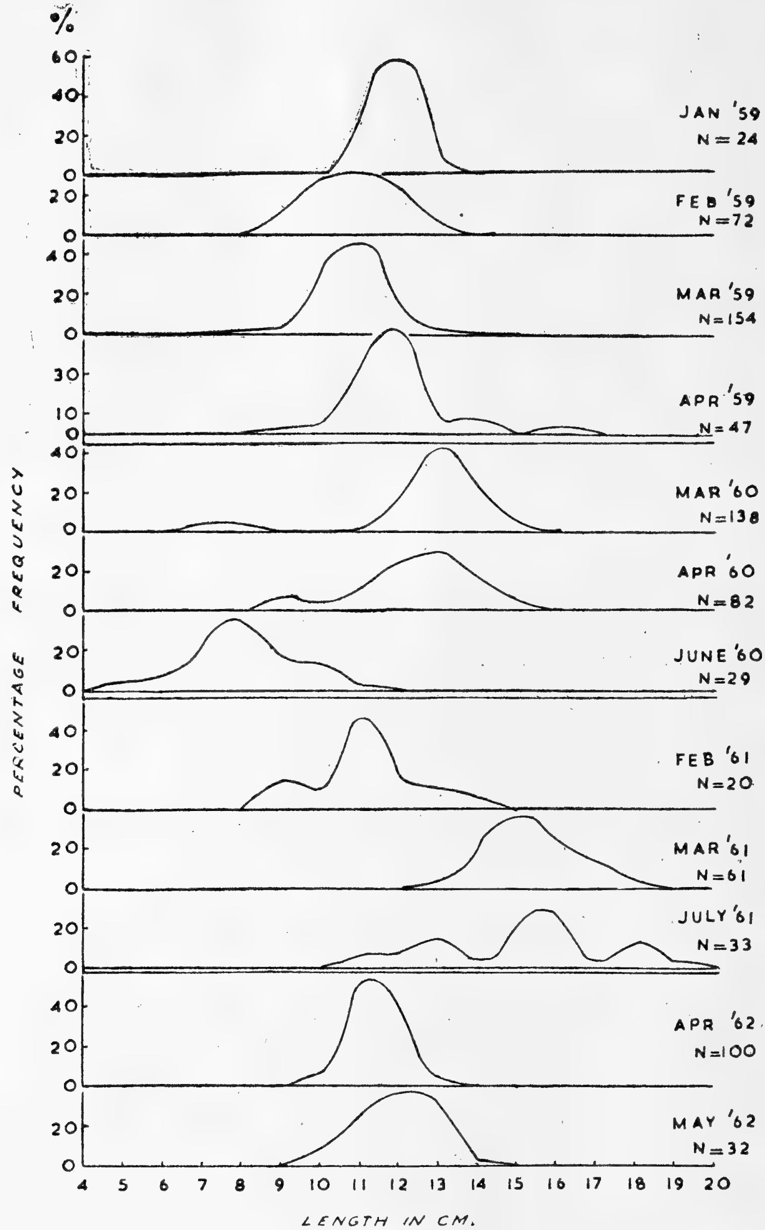

FIG. 2. HILSA ILISHA: LENGTH FREQUENCY CURVES FOR THE JUVENILES COLLECTED IN THE FOUR SEASONS.

The length-weight data of the four years (1959, 1960, 1961 and 1962) have been subjected to analysis of covariance (Goulden 1939) to see

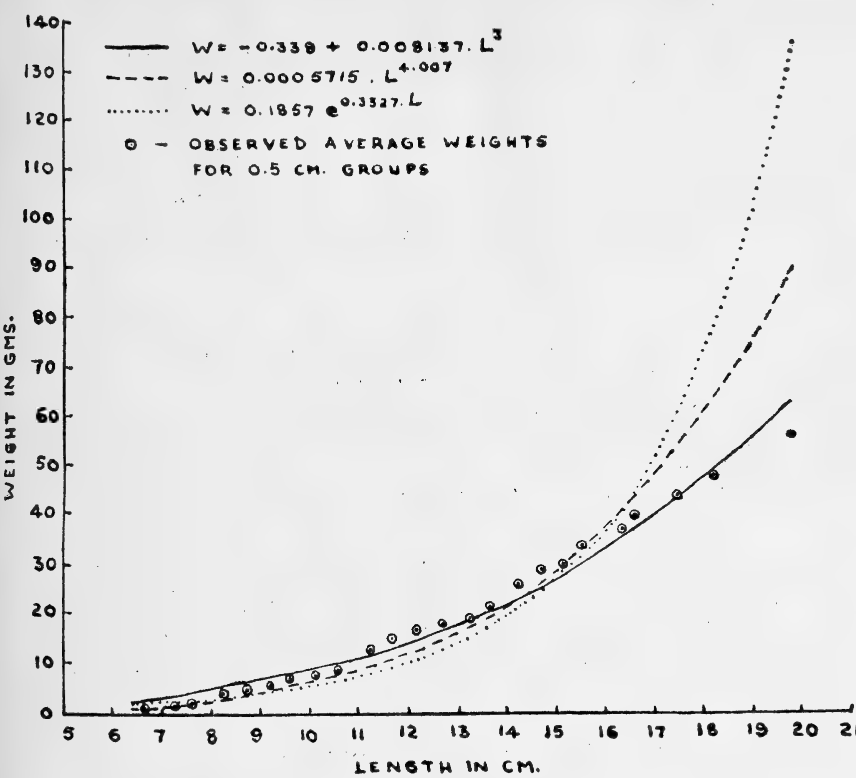

FIG. 3. LENGTH—WEIGHT RELATIONSHIP (1960 JUVENILES)

whether the juveniles of the different years (representing different year classes) belong to a homogeneous group or not with regard to the length-weight relationship (Table 3). The 'F' value was found to be significant indicating that significant differences exist between the different years. Comparison of regression coefficients of different years by means of 't' test reveals that, except for juveniles of 1959 and 1961, juveniles of any two years differ significantly from one another with regard to the length-weight relationship (Table 4). This might be due to one or both of two reasons : (i) general tendency of variation between the different year classes and (ii) difference in the environmental conditions during different years affecting the general 'condition' (well-being) of the fish which is reflected on the length-weight relationship.

TABLE 1

SUM OF SQUARED DIFFERENCES OF THE OBSERVED AND CALCULATED WEIGHTS FOR THE LENGTH-WEIGHT DATA OF JUVENILES COLLECTED IN 1960

Equation	$\sum(Wo-Wc)^2$
$W=c.\,L^n$	1,672·0546
$W=Ae^{b.L}$	7,816·0683
$W=a+b.\,L^3$	121·4663

TABLE 2

EQUATIONS EXPRESSING LENGTH-WEIGHT RELATIONSHIP OF JUVENILES OF THE YEARS 1959, 1960, 1961 AND 1962

Juveniles collected in the year	n	Length range	Equation
1959	95	9-14 cm.	$W=-3{\cdot}723+0{\cdot}009603.\,L^3$
1960	163	6-19 cm.	$W=-0{\cdot}339+0{\cdot}008137.\,L^3$
1961	57	13-19 cm.	$W=-2{\cdot}383+0{\cdot}009209.\,L^3$
1962	91	10-15 cm.	$W=\ 0{\cdot}309+0{\cdot}007224.\,L^3$

STATISTICAL ANALYSIS OF BIOMETRIC DATA

The biometric data obtained from the juveniles of different years were subjected to statistical analysis to see whether the species occurring in the estuary strictly belongs to a homogeneous stock or the species shows variation in the different year classes.

The following biometric data were obtained from the juveniles collected during the three years 1959, 1960 and 1961.

Meristic data :

1. Pectoral fin rays.
2. Ventral scutes.
3. Vertebrae.

Morphometric data :

1. Standard length.
2. Body depth.
3. Head length.

Data for the pectoral fin rays are available for the juveniles of 1962 season also in addition to the above three years.

TABLE 3

ANALYSIS OF COVARIANCE APPLIED TO THE LENGTH-WEIGHT DATA OF THE JUVENILES OF THE FOUR YEARS 1959, 1960, 1961 AND 1962

	(1) D.F.	(2) $\Sigma(X-\bar{X})^2$	(3) $\Sigma(x-\bar{x})(y-\bar{y})$	(4) $\Sigma(y-\bar{y})^2$	(5) b	(6) $b.\Sigma(x-\bar{x})(y-\bar{y})$	(7) $\Sigma y'^2$	(8) D.F.
1959	8	3,610,410	34,672·26	337·1530	0·009603	332·9580	4·1950	7
1960	23	91,118,020	741,459·47	6,120·9224	0·008137	6033·2557	87·6667	22
1961	10	19,398,380	178,644·00	1,654·5100	0·009209	1645·1326	9·3774	9
1962	8	4,127,934	29,821·94	216·2719	0·007224	215·4337	0·8382	7
Total	49	118,254,744	984,597·67	8,328·8573	0·008324	8195·7910	133·0663	48

(1) D.F. for unadjusted sums of squares (2) S.S. of 'x' variate (3) Sums of products (4) S.S. of 'y' variate (5) regression coefficients (7) adjusted sums of squares (8) D.F. for adjusted sums of squares.

TEST OF HETEROGENEITY OF REGRESSION BETWEEN SEASONS

	D.F.	Adjusted sums of squares	Variance	F	5% Point	Significance
Total ..	(pq-1) 48	133·0663				
Within Seasons	(pq-p) 45	102·0773	2·2684 (V_1)			
Difference	(p-1) 3	30·9890	10·3297 (V_2)	4·554	2·82	Significant

The notation used is the same as that adopted by Goulden (1939 : 253-254).

TABLE 4

TEST OF SIGNIFICANCE OF THE DIFFERENCE BETWEEN THE REGRESSION COEFFICIENTS OF THE JUVENILES OF THE FOUR YEARS IN THE LENGTH-WEIGHT DATA

	Seasons Compared					
	1959			1960		1961
	1960	1961	1962	1961	1962	1962
σdb	0·0004868	0·0004776	0·0004462	0·0003355	0·0002885	0·000273
db	0·001466	0·000394	0·002379	0·001072	0·000913	0·001985
't'	3·011	0·8249	5·332	3·196	3·164	7·271
d.f.	29	16	14	31	29	16
P	<0·05	>0·05	<0.05	<0·05	<0·05	<0·05
Significance	Significant	Not Significant	Significant	Significant	Significant	Significant

σdb = Standard error of difference of the regression coefficients compared.
d_b = Difference of the regression coefficients : d.f. = degrees of freedom.
P = Probability level.

Pectoral fin rays : A comparison of the juveniles of the four years 1959, 1960, 1961 and 1962 (evidently belonging to different year-classes) by means of Chi-square test, shows significant differences in the number of pectoral fin rays (Table 5). The frequency distributions of the four year-classes reveal that the juveniles of 1961 season have a relatively lower number of pectoral fin rays than those of the other seasons. When the Chi-square test was applied to the data of 1959, 1960 and 1962 seasons (excluding 1961 season) the result was not significant indicating that only the juveniles of 1961 season show a significant difference from the others. This was confirmed by applying Chi-square test to the pooled data of the three years 1959, 1960 and 1962 on one hand and 1961 data on the other which gave a significant result (Table 5).

Scutes : When the samples of the three seasons, 1959, 1960 and 1961 were tested for homogeneity in the number of scutes (Table 6a), the Chi-square value (Table 6b) indicates, that there were no significant differences between the different year-classes.

Vertebrae : The samples of the three seasons 1959, 1960 and 1961 show heterogeneity when tested by means of Chi-square test (Table 7). When the frequency distributions of the three seasons were examined, the juveniles of 1961 season were found to have a lower number of vertebrae than the other two seasons (Table 7A). When the juveniles of 1959 and 1960 alone were tested, the result was not significant indicating that only the juveniles of 1961 season have a significantly lower number of vertebrae. This was also confirmed by taking the pooled data of 1959 and 1960 seasons on one hand and 1961 season data on the other and applying the Chi-square test. The result has shown significant difference.

TABLE 5

NUMBER OF PECTORAL FIN RAYS OF JUVENILES OF THE FOUR YEARS

(A) FREQUENCY DISTRIBUTION

Juveniles of the season	No. of pectoral fin rays				
	14	15	16	17	n
1959 ..	46	195	58	1	300
1960 ..	25	158	40	—	223
1961 ..	24	87	8	1	120
1962 ..	18	107	21	—	146

(B) Chi-square test applied to data of different seasons

Seasons compared	Obs. χ^2	d.f.	P	Significance	Remarks
(i) 1959, 1960, 1961 and 1962	14·6707	6	<0·05	Significant	In all cases classes 16 and 17 are bracketed.
(ii) 1959, 1960 and 1962 (excluding 1961 juveniles)	4·4756	4	>0·05	Not Significant	
(iii) 1959, 1960 and 1962 pooled with 1961 juveniles.	10·1702	2	<0·01	Significant	

Table 6

Total number of scutes of the juveniles

(A) Frequency distribution

Juveniles of the Season	Number of Scutes					n
	29	30	31	32	33	
1959 ..	2	23	213	40	1	279
1960 ..	—	9	126	40	—	175
1961 ..	—	10	84	18	1	113

(B) Chi-square test applied to data of different seasons

Obs. χ^2	d.f.	P	Significance	Remarks
6·6282	4	>0.05	Not Significant	Classes 29, 30, 32, and 33 are bracketed.

Table 7

Number of Vertebrae of the juveniles of the three years

(A) Frequency distribution

Juveniles of the season	No. of vertebrae					n
	44	45	46	47	48	
1959 ..	—	25	230	18	1	274
1960 ..	—	13	127	14	—	154
1961 ..	1	6	15	1	—	23

(B) CHI-SQUARE TEST APPLIED TO THE DATA OF DIFFERENT SEASONS

Seasons compared	Obs. χ^2	d.f.	P	Significance	Remarks
(i) 1959, 1960 and 1961 taken separately	11·3381	2	<0.005	Significant	—
(ii) 1959 and 1960 taken separately, excluding 1961	0·0021	1	>0.05	Not Significant	Classes 44, 45, 46, 47, and 48 are bracketed, in all cases.
(iii) 1959 and 1960 pooled and 1961 compared.	9·0200	1	<0.005	Significant	—

Body measurements : When the data of height on standard length from the samples of the three seasons 1959, 1960 and 1961 were subjected to analysis of covariance (Kendall 1946) a significant result was obtained (Table 8) indicating that a single regression equation will not represent all three class relations (year classes). Hence the individual year classes were compared by the 't' test (Table 9). The results show that the juveniles of 1960 and 1961 seasons differ significantly in height, while the juveniles of 1959 season do not differ from either of the other two seasons. Similarly analysis of covariance (Table 10) and test of significance (Table 11) applied to the juveniles of the above three seasons with respect to the regressions of head length on standard length, show that the juveniles of the 1959 season differ significantly from those of 1960 season, whereas the juveniles of the 1961 season do not differ from those of either the 1959 or 1960 season.

TABLE 8

ANALYSIS OF COVARIANCE : HEIGHT ON STANDARD LENGTH IN JUVENILES OF THE SEASONS: 1959, 1960 AND 1961

(a) SUMS OF SQUARES AND PRODUCTS AND REGRESSIONS

Source of variation	d.f.	S.S. x^2	S.S. y^2	S.P. xy	Regressions b
	$(n_j - 1)$	(C_{11j})	(C_{22j})	(C_{12j})	(b_j)
Within 1959 season ..	50	45·4914	7·0644	17·3479	0·38134
Within 1960 season ..	109	445·2169	69·2573	175·1625	0·39343
Within 1961 season ..	57	42·5474	5·4405	15·0740	0·35429
	(N-p)	(C_{11a})	(C_{22a})	(C_{12a})	(b_a)
Within seasons ..	216	533·2557	81·7622	207·5844	0·38928
Between seasons ..	(p-1)	(C_{11m})	(C_{22m})	(C_{12m})	(b_m)
	2	358·8542	34·8134	108·6930	0·30289
	(N-1)	(C_{11o})	(C_{22o})	(C_{12o})	(b_o)
Totals ..	218	892·1099	116·5756	316·2774	0·35453

(b) LINEAR REGRESSIONS

Variation due to	d.f.	Sums of squares	Quotient
Deviations from linear regression within seasons	(N-2p) 213	$S_1=0{\cdot}8919$	0·00419
Differences among regressions	(p-1) 2	$S_2=0{\cdot}0617$	0·03087
Deviations within seasons from linear regression b_a	(N-p-1) 215	$S_1+S_2=0{\cdot}9536$	0·00444
Deviations between seasons from linear regression b_m	(p-2) 1	$S_3=1{\cdot}8913$	1·89131
Differences between b_a and b_m	1	$S_4=1{\cdot}6008$	1·60084
Total deviations from linear regression b_o	(N-2) 217	$S_1+S_2+S_3+S_4=4{\cdot}4457$	

$$F=\frac{(N-2p)}{S_1}\times\frac{S_2+S_3+S_4}{2p-2} \text{ with } (2p\text{-}2) \text{ and } (N-2p) \text{ d.f.}$$

$$F=\frac{213}{0{\cdot}8919}\times\frac{3{\cdot}5538}{4}=212{\cdot}18^{**} \text{ with 4 and 213 d.f.}$$

** Highly significant.

The notation is from Kendall (1946).

TABLE 9

TEST OF SIGNIFICANCE OF THE DIFFERENCE BETWEEN REGRESSION COEFFICIENTS OF HEIGHT ON STANDARD LENGTH, IN THE JUVENILES OF THE THREE SEASONS: 1959, 1960 AND 1961

	1959 and 1960	1959 and 1961	1960 and 1961
σd_b	0·01444	0·01929	0·01331
d_b	0·01209	0·02705	0·03914
t	0·837	1·402	2·941
d.f.	157	105	164
P	>0·05	>0·05	<0·05
Significance	Not Significant	Not Significant	Significant

σd_b = Standard error of difference.

d_b = Differences in the regression coefficients.

d.f. = Degrees of freedom.

P = Probability level.

TABLE 10

ANALYSIS OF COVARIANCE : HEAD LENGTH ON STANDARD LENGTH IN JUVENILES OF THE SEASONS : 1959, 1960 AND 1961

(a) SUMS OF SQUARES AND PRODUCTS AND REGRESSIONS

Source of variation	d.f.	S.S. x^2	S.S. y^2	S.P. xy	Regressions b
	(n_j-1)	(C_{11j})	(C_{22j})	(C_{12j})	(b_j)
Within 1959 season	50	45·4914	3·4248	12·1250	0·26653
Within 1960 season	109	445·2169	37·7967	128·1175	0·28776
Within 1961 season	57	42·5474	3·4258	11·1355	0·26172
	(N-p)	(C_{11a})	(C_{22a})	(C_{12a})	(b_a)
Within Seasons	216	533.2557	44.6473	151.3780	0.28388
	(p-1)	(C_{11m})	(C_{22m})	(C_{12m})	(b_m)
Between Seasons	2	358·8542	25·1768	94·8738	0·26438
	(N-1)	(C_{11o})	(C_{22o})	(C_{12o})	(b_o)
Totals	218	892·1099	69·8241	246·2518	0·27603

(b) LINEAR REGRESSIONS

Variation due to	d.f.	Sums of squares	Quotient
Deviations from linear regression within seasons	(N-2p) 213	S_1=1·6341	0·00767
Differences among regressions	(p-1) 2	S_2=0·0400	0·02000
Deviations within seasons from linear regression b_a	(N-p-1) 215	S_1+S_2=1·6741	0·00779
Deviations between seasons from linear regressions b_m	(p-2) 1	S_3=0·0941	0·09405
Differences between b_a and b_m	1	S_4=0·0829	0·08290
Total deviations from linear regression b_o	(N-2) 217	$S_1+S_2+S_3+S_4$ 1·8511	

$$F=\frac{(N-2p)}{S_1}\times\frac{S_2+S_3+S_4}{2p-2} \text{ with } (2p-2) \text{ and } (N-2p) \text{ d.f.}$$

$$F=\frac{213}{1·6341}\times\frac{0.2170}{4}=7·07^{**} \text{ with 4 and 213 d.f.}$$

** Highly significant.

The notation is from Kendall (1946).

TABLE 11

TEST OF SIGNIFICANCE OF THE DIFFERENCES BETWEEN REGRESSION COEFFICIENTS OF HEAD LENGTH ON STANDARD LENGTH, IN THE JUVENILES OF THE THREE SEASONS: 1959, 1960, AND 1961

	1959 and 1960	1959 and 1961	1960 and 1961
σd_b	0·01029	0·01735	0·01529
d_b	0·02123	0·00481	0·02604
t	2·060	0·277	1·703
d.f.	157	105	164
P	<0.05	>0·05	>0·05
Significance	Significant	Not Significant	Not Significant

σd_b = Standard error of difference.
d_b = Differences in the regression coefficients.
d.f. = degrees of freedom.

Thus the above tests applied to the different morphometric and meristic characters of the juveniles collected during different seasons and consequently belonging to different year-classes, indicate that the year classes differ from one another in one or more characters. This also holds good with regard to the length-weight relationship of the juveniles of the different years.

SUMMARY

Adult *Hilsa* migrate up the Godavari during the south-west monsoon and after a brief lull, during the winter. The spent adults of the monsoon migration return to the sea from October to December and those of the post-monsoon migration from April to early June. In addition to the maturing, mature and spent adults, immature forms occur in the estuary from January to July. The Gautami branch accounts for more fishery than the other two branches of the river, Vasishta and Vainateyam.

The length-weight relationship of the juveniles of the different seasons, is expressed by the following equations:

1959 : $W = -3{\cdot}723 + 0{\cdot}009603.L^3$
1960 : $W = -0{\cdot}339 + 0{\cdot}008137.L^3$
1961 : $W = -2{\cdot}383 + 0{\cdot}009209.L^3$
1962 : $W = 0{\cdot}309 + 0{\cdot}007224.L^3$

Application of analysis of covariance and 't' test to the length-weight data of the four seasons has revealed that except juveniles of 1959 and 1961 seasons, juveniles of any two years differ significantly from one another.

The different year-classes differ from one another in one or more morphometric and meristic characters.

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Birds of Thakkhola, North Nepal

BY

ROBERT L. FLEMING, JR.

Woodstock School, Mussoorie, U.P., India[1]

(*With a photograph*)

Observations are recorded on 22 species of birds found in December in the dry zone north of the Dhaulagiri and Annapurna massifs. Birds were studied in an altitudinal range of from 8,400 feet (2562 m.) to 18,000 feet (5485 m.). It was found that above 12,000 feet (3655 m.) species diversity decreases sharply. The Hill Pigeon, *Columba rupestris* Pallas, is reported from Nepal for the first time. In addition, the Stoliczka's Tit-Warbler, *Leptopoecile sophiae* Severtzov, the Eastern Great Rosefinch, *Carpodacus rubicilloides* Przevalski, and the Brown Accentor, *Prunella fulvescens* (Severtzov) were collected for the second time in Nepal.

INTRODUCTION

Few ornithologists working in Nepal have reported on birds from north of the main Himalayan axis. Fleming (see Rand & Fleming 1957) visited Thakkhola in 1949, and Lowndes (1955) collected in the Managbhot area in 1950. The data presented here were gathered on a trip in Thakkhola during December 1963 and January 1964.

Travel in Nepal is greatly facilitated by scheduled flights of the Royal Nepal Airlines. We flew from Kathmandu to Pokhara where we engaged porters for the remainder of the trip. Muktinath, our ultimate destination in Thakkhola, is a comfortable 18 day round-trip trek from Pokhara. Birds were collected with a .22/410 over-under gun. Altitudes were determined with the aid of a Taylor altimeter. Scientific terminology follows that given by Ripley (1961). Specimens secured are now in the Field Museum of Natural History, Chicago, and in the Nepal Collection in Kathmandu.

Thakkhola is situated along the Kali Gandaki River, between 28 degrees and 29 degrees N. latitude, with Mustang on the north and Baglung to the south. Dhaulagiri (26,785 feet above msl) looms to the west and Annapurna (26,452 feet) rises on the south-east. This is the land of the Thakkhalis, a people widely known for their trading ability and hospitality.

Part of Thakkhola lies north of the Dhaulagiri-Annapurna massifs where the dry climate supports a number of xeric-type thorn bushes plus

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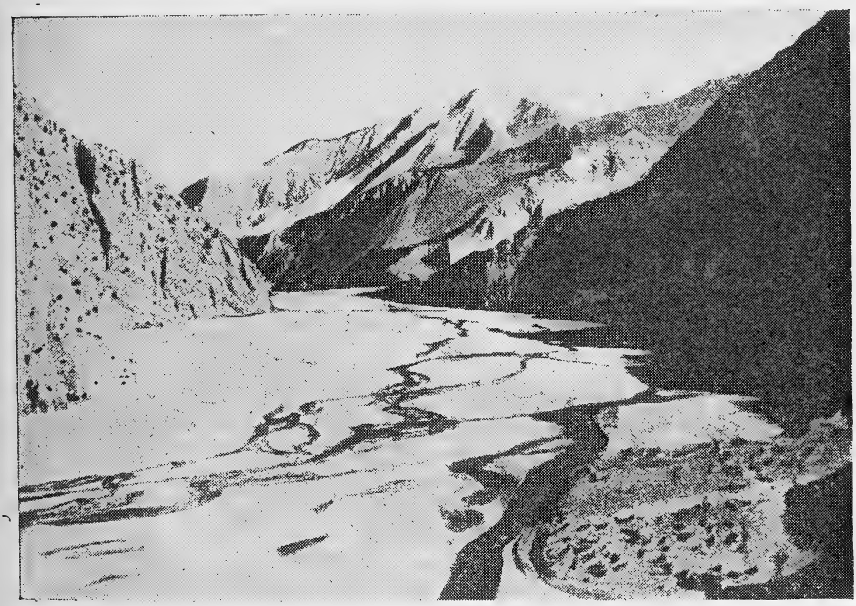
[1] Present address : Office of Ecology, Smithsonian Institution, Washington, D.C.

several grasses (see Kihara 1955). *Cupressus* occurs in the lower valleys with a recumbent *Juniperus* clinging to slopes up to *c.* 16,000 feet (4875 m.).

The remarkable Gandaki gorge between Dhaulagiri and Annapurna (see Hagen 1961) is a definite hindrance to human travel, but does not seem to be a noticeable barrier to the north-south movements of birds. For example we found common mynas, *Acridotheres tristis* (Linnaeus), just south of the gorge and also noted six perched on tops of roofs in Ghasa, the first village above the gorge.

North of the gorge, the river-bed rises for *c.* 10 kilometres, then abruptly levels off, narrows to about 50 metres at a point we call the ' gap ', and then broadens into a valley approximately 800 metres wide. Here the river runs in several shallow channels across the stony floor. To the north of the ' gap ' the landscape appears largely barren with dark dots of *Cupressus* and *Juniperus* (Photo), while to the south the valley sides are clothed with *Pinus* and *Taxus* over a shrub layer of bamboos.



Looking north from Jomsom. The altitude of the Kali Gandaki Valley floor is *c.* 9,000 feet (2745 m.). *Juniperus* dots the slopes in the background. 19 December, 1963.

The bird life also changes noticeably from south of the gap to north of it. The following sample illustrates this change :

Species noted up to within 1 km. south of the gap.

Whitecapped Redstart, *Chaimarrornis leucocephalus* (Vigors)
Spotted Forktail, *Enicurus maculatus* Vigors
Whistling Thrush, *Myiophoneus caeruleus* (Scopoli)

Species noted down to within 1 km. north of the gap.
Rock Bunting, *Emberiza cia* Linnaeus
Raven, *Corvus corax* Linnaeus
Redbilled Chough, *Pyrrhocorax pyrrhocorax* (Linnaeus)

Species noted within 1 km. on both sides of the gap.
Jungle Crow, *Corvus macrorhynchos* Wagler
White Wagtail, *Motacilla alba* Linnaeus
Wall Creeper, *Tichodroma muraria* (Linnaeus)

A listing of species noted within 3 km. south and 3 km. north of the gap would show considerably greater divergence and the transition from the avifauna of the southern slopes to the birds of the dry northern slopes occurs in less than six kilometres.

The altitudinal distribution of birds is partially influenced by weather : a severe snow storm is known to drive birds down hill. In 1949 my father's party was caught in a heavy snow fall during which they collected a number of high altitude species down in the main Kali valley (Rand & Fleming 1957). We also prepared for snow but experienced 20 days of cloudless skies and consequently found birds at a higher altitude than those recorded in 1949.

Table 1

Species Diversity of Birds at different altitudes in North Thakkhola in December

Altitude*	Number of species noted
9·0 (2745 m.)	15
10·0	12
11·0	12
12·0	11
13·0	5
14·0	6
15·0	7
16·0	7
17·0	2
18·0 (5485 m.)	0

* in thousands of feet.

Table 1 shows the number of species observed in N. Thakkhola at intervals of 1,000 feet (305 m.) altitude. The most noticeable change in the species diversity occurs between 12,000 feet (3655 m.) and 13,000 feet (3960 m.). We felt that the reduction of birds above 12,000 feet is largely due to the timber line (of what few trees there are) at roughly 12,000 feet and to the absence of villages with fields and hedgerows above 12,000 feet. Relatively little change in the species composition occurs from

9,000 to 12,000 feet, but then there is a marked shift after which the small group of species occurring above 13,000 feet remains relatively stable. The birds recorded at 16,000 feet (4875 m.) were : the Golden Eagle, *Aquila chrysaëtos* (Linnaeus) ; the Himalayan Griffon, *Gyps himalayensis* Hume ; the Snow Cock, *Tetraogallus* sp. ; the Yellowbilled Chough, *Pyrrhocorax graculus* (Linnaeus) ; Jungle Crow, *Corvus macrorhynchos* Wagler ; the Alpine Accentor, *Prunella collaris* (Scopoli), and the Red-breasted Rosefinch, *Carpodacus puniceus* (Blyth). Of these seven species, only the Jungle Crow was seen throughout the altitudinal range under consideration. As expected, all species noted above 9,000 feet (2745 m.) were of Palaearctic affinity.

Account of Species

Aquila chrysaëtos (Linnaeus)

Golden eagles have not been collected in Nepal for well over a hundred years, but they have been seen in Central and Eastern Nepal (Biswas 1960 : 287). We found them conspicuous but infrequent between 12,000 and 16,000 feet on the slopes above Tinigoan. On 22 Dec. we were climbing along the main path about 6 km. above Tinigoan when we came over a slight rise to surprise a Golden Eagle as it attacked a domestic goat. The huge bird, with its head bent forward, talons extended and wings flapping high over the shoulders, swiftly closed in on the ram which had strayed about 25 m. from the main herd. Evidently at the last instant, the eagle decided that the animal was too large for it swerved to the side and hit the ground less than a metre from the goat. At this point we thought the ram would launch a counter attack but it stood motionless, without even turning its head. After approximately two seconds the eagle took to the air and quickly ascended into the sky. Soon it was joined by another and after some minutes of aerial acrobatics, both birds flew to projections in the yellow-brown cliffs above us.

Gypaëtus barbatus (Linnaeus)

The Lämmergeier is not generally common in Nepal (Biswas 1960 : 290-291). North of Tukche we frequently met this large scavenger up to an altitude of 10,000 feet (3050 m.). On Dec. 18 we ate lunch behind a stone wall and simultaneously watched a lämmergeier as it fought the 40 mile per hour wind (which blows down from Dhaulagiri and up over Mustang) while looking for food on the valley floor.

Gyps himalayensis Hume

The Himalayan Griffon Vulture is the high altitude vulture of the Thakkhola area. We often saw it sailing up to at least 16,000 feet as it moved over the grassy hills of the region.

Tetraogallus sp.

Two flocks of Snow Cocks were seen on the ridges above Tinigoan. Eight birds were noted hopping up stone scree on a north slope while a group of three birds first ran and then flushed from a grass and juniper covered south slope.

We were anxious to find the Tibetan Partridge, *Perdix hodgsoniae* (Hodgson). Deva Nur Singh of Jomsom showed us where they had been collected in 1949 (Rand & Fleming 1957 : 60) but in 1963 neither birds nor tracks were apparent. Mr. Singh said that for some reason this partridge has been rare here for the last several years. It may be coincidental, but the partridge population apparently declined when a domestic yak herd formerly located here was wiped out through disease.

Alectoris graeca (Meisner)

We were told that the Chukor Partridge is common in the fields around Jomsom and that they are seen in large flocks. We did not see great numbers of this partridge, but did collect one bird from a barren slope at 9,000 feet (2745 m.) and saw others in the fields of Tinigoan.

Columba rupestris Pallas

The Hill Pigeon has not been reported from Nepal (Biswas 1960 : 530-531). On 19 Dec. we were approaching Zarkot village at 11,000 feet (3350 m.) when a flock of four of these birds flew over us and landed in a fallow field. We stalked to within 90 metres of the birds, but they were shy and flushed quickly so we were unable to secure a specimen.

Columba livia Gmelin

Blue Rock Pigeons were common near villages along the Kali Gandaki valley floor. It is of interest to note that Snow Pigeons, *Columba leuconota* Vigors, were not seen in Thakkhola for they had moved down to their winter quarters. We met them at 5,000 feet (1525 m.), south of the main Gandaki gorge, where we noted several large flocks frequenting the cliffs near Dana.

Pyrrhocorax graculus (Linnaeus)

The Yellowbilled Chough was common above Tinigoan and Muktinath. On the evening of 22 Dec., while at our camp above Tinigoan, we watched a hundred birds or more come noisily down the hill, feeding from one juniper bush to another. When one of these birds was shot, the rest immediately wheeled into the air and in less than two minutes had ascended three thousand feet elevation and disappeared over the ridge. The next day we collected another specimen at about 14,500 feet (4420 m.) as a flock, moving from juniper to juniper, passed us.

Pyrrhocorax pyrrhocorax (Linnaeus)

Large flocks (of over 50 birds) flew about the walls of the Gandaki valley and fed in fallow and plowed fields along the river. In Managbhot these two species of Choughs are often in company (Lowndes 1955 : 30) but we did not see them together here.

Corvus macrorhynchos Wagler

Jungle Crows were common around Tukche and were seen either singly or in pairs up to 16,000 feet (4875 m.).

Corvus corax Linnaeus

Ravens have not officially been collected in Nepal (Biswas 1963 : 654) although they have been seen by many mountaineering parties. We noted solitary Ravens on two occasions, both times close to the waters of the Gandaki. It appears that Ravens regularly straggle south as far as Tukche (8,400 feet) during the winter.

Leptopoecile sophiae Severtzov

The Stoliczka's Tit-Warbler is a common bird of Thakkhola. This species was first collected in Nepal by Dr. R. Fleming, Sr. and he reported it as rare in 1949 (Rand & Fleming 1957 : 173). We found these interesting little birds in the *Cupressus* stands just north of Tukche (at 8,400 feet) up to the hedges and bushes around Zarkot (at 11,000 feet). They were usually in pairs or small groups. At one point we watched a flock of six birds as they moved along close to the ground but with frequent pauses to climb atop small bushes. From here, with their tails cocked in the air much in the manner of the Magpie-Robin, *Copsychus saularis* (Linnaeus), they would call loudly and then fly off to the base of the next bush.

Phoenicurus schisticeps (Gray)

The colourful Whitethroated Redstart was seen sparingly in three places : along the Gandak River just north of Tukche, around the Muktinath shrine at 11,300 feet, and near our camp above Tinigoan at 12,500 feet. On the evening of 23 December I was waiting near a spring when suddenly a bird ' whooshed ' over my head in the manner of a diving falcon and landed on a *Juniperus* tree nearby. It immediately was collected and turned out to be a male Whitethroated Redstart that apparently was coming for a drink from the pool of water formed from the sun-melted ice.

Prunella collaris (Scopoli)

Solitary Alpine Accentors were seen in several places. One frequented the ledges of the Muktinath dharamshala while others were seen up to 16,000 feet. These birds often sat on a cold boulder in the midst of snow and never appeared very energetic. A specimen collected below our Tinigoan camp, at 11,000 feet, was the lowest altitude bird seen.

Prunella rubeculoides (Horsfield and Moore)

The Robin Accentor did not appear to be common in this area. On the evening of 23 December we were huddled around our fire in a yak shelter when at sunset a bird that looked like a bush robin hopped up and perched on a vertical stick just outside the low door. Soon it dipped down into the cover of the surrounding bushes. When pursued it led a merry chase through and around several bushes, often doubling back on its path to emerge at a completely unexpected spot. Finally it was collected and identified as the Robin Accentor.

Prunella fulvescens (Severtzov)

We found a small party of Brown Accentors near the path above Kag Beni at an altitude of *c*. 10,000 feet. Eight birds were feeding together on rock scree above the path. On the first stalk I disturbed the flock but they flew only a little way to settle again on the ground and in a small thorn bush. When a specimen was collected from the thorn bush, the flock disappeared over the ridge and was not seen again.

Tichodroma muraria (Linnaeus)

Solitary Wall Creepers were often seen along the main Gandak valley but did not appear frequently above Jomsom.

Passer montanus (Linnaeus)

Tree Sparrows were extremely common around all of the large villages in Thakkhola. The largest flock, of some 150 birds, was seen near Zarkot at 11,000 feet (3350 m.).

Leucosticte nemoricola (Hodgson)

Hodgson's Mountain Finches were seen infrequently. Flocks with over 50 birds perched in bare trees both slightly above and slightly below Zarkot at 11,000 feet.

Carpodacus rubicilloides Przevalski

The Eastern Great Rosefinch was collected in this area in 1949 (Rand & Fleming 1957 : 205). We found this species of Rosefinch in bushes bordering fields near Zarkot at *c*. 11,000 feet.

Carpodacus puniceus (Blyth)

The Redbreasted Rosefinch was the high altitude finch above Muktinath. We met one party, consisting of two birds in brown plumage and one in pale crimson plumage, amongst rocks at 15,000 feet (4575 m.). Another bird, a male, was observed as it sang a short, musical melody while perched on a large rock in the midst of a snow field at 16,000 feet. Several other Rosefinches were seen and collected in Thakkhola. They were especially common in hedges bordering fields where the most numerous appeared to be the Beautiful Rosefinch, *Carpodacus pulcherrimus* (Moore).

Emberiza cia Linnaeus

The Rock Bunting was only recently collected in Nepal (Biswas 1963 : 191-192). We found it to be one of the commonest birds of Thakkhola up to an altitude of 12,000 feet (3655 m.) and as it must be common in other suitable areas, it is strange that it was not collected until 1949.

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Dr. Denis Roche, UMN Hospital, Bhaktapur, Nepal and Richard Friedericks of Tansen, Palpa, Nepal, accompanied me on this study trip and assisted in innumerable ways from starting fires to preparing bird skins. Dr. R. L. Fleming, Sr. greatly helped in making arrangements for the trip. We were cordially received and assisted by the Sher Chan family of Tukche. We are also most grateful to Shri Deva Nur Singh of Jomsom who took several days out of his schedule to show us good collecting places above Jomsom. We also wish to thank the Foreign Office and Forest Department of His Majesty's Government for permission to trek and collect in Thakkhola, Nepal.

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Reviews

1. EXTINCT AND VANISHING ANIMALS. By Vinzenz Ziswiler. pp. 136 (23×15 cm.). With 74 text-figures. London, 1967. Longmans. Price 35*s*. net.

This book, recommended by the World Wildlife Fund, presents a brief but interesting review of the progressive destruction of nature, particularly of animal life, surveys the dismal history of elimination of species and examines some of the means at our disposal for preventing further losses. The book has two comprehensive appendices; the first containing a list of about 200 bird and mammal forms already extinct, and the second a list of about 250 reptiles, birds and mammals that are 'most gravely threatened'. The first chapter describes in detail how direct extermination of animals takes place through human greed for meat, eggs, hides, furs, feathers and through superstitious beliefs. Of relevance to Indian conditions are examples of the souvenir trade in elephant feet for use as waste paper baskets and the trade in leopard skins. The destruction of the rhino by poachers is mainly aimed at securing the horn which is believed to be an aphrodisiac. The impact of the live-animal trade on the direct extermination of animals is also considerable. The second chapter deals with indirect extermination and describes the well-known aspects of destruction of natural vegetation, drainage of wet lands, and interference with water used or needed by animals. Local extermination and the biology of extermination are the topics of the third and fourth chapters, while the last chapter is devoted to the subject of protecting nature through conservation, restoration and wild life management. Of interest to Indian readers is the entry in Appendix I, relating to the Pink-headed Duck which is shown to have become extinct in 1940, on account of being hunted for meat. The second Appendix has five entries of relevance to India, showing 'most gravely threatened animal forms', and the reasons (by means of key symbols). Among carnivores, is listed the Indian Cheetah; it is, however, known that unfortunately the Indian Cheetah has already become extinct, and the last known cheetah was shot some 25 years ago in Central India. The other entries in this list are the Indian Lion whose population in the Gir Forest is shown as 250, the Great Indian Rhinoceros whose population in India and Nepal is shown as 600, the Nilgiri Tahr whose population in south India is shown as 800, and lastly the Pigmy Hog which is shown as occurring in Nepal, Sikkim and Assam and is facing extinction (population not known). In lists containing several hundred entries, there are bound to be some errors but these do not detract from the value and usefulness of the book. A great deal of labour must have gone into the compilation of the detailed lists, for all regions of the world, and the author deserves congratulations on the effort.

The revised English edition by Fred and Pille Bunnell deals quite adequately in a small compass with the problems of extinct and vanishing animals, and the book is opportune at this juncture in India where several species of animals are known to be on the road to extinction and where the survival of several others has become difficult. It deserves careful study at the hands of those charged with the task of conservation of nature and of animals in India. The book has been beautifully got up.

G. V. B.

2. THE LAST OF THE WILD: ON THE TRACT OF RARE ANIMALS. By Eugen Schuhmacher. pp. 315 (27·5×21·5 cm.), with 159 coloured plates. London 1968. Collins. Price 4 *gns.* net.

Eugen Schuhmacher spent 7 years on all continents filming rare animals. As Prince Bernhard of the Netherlands, President of the World Wild Life Fund says in the Foreword, the book is an impressive photographic record of species that are in danger of extinction.

In the Introduction to another similar book, VANISHING WILD ANIMALS OF THE WORLD, Peter Scott said: 'Nowadays most people feel that it is a bad thing when a species becomes extinct at the hands of man. The case has been made that it is morally wrong; it may also be foolish and improvident because every living thing plays a part in the inter-dependent system and eliminating any may have unexpected effects on all—including man himself. If the game guards of 60 years ago had not destroyed most of the birds of prey in Britain, we might not now have wood pigeon and starling problems on our farms'.

During the past 2000 years at least 2000 mammals have become extinct, but what is more alarming is that the rate of extinction continues to be as high as one mammal every year. Under the circumstances every effort made by anyone to publicize the plight of wild life in danger in any corner of the world is supremely important. The information must be presented in such a way that it evokes a positive response in the common man, who is now the arbiter of our future destiny, and there is no better way of doing so than by showing films, presenting photographs, and writing interestingly about the species that are endangered.

In this, Eugen Schuhmacher has succeeded to a remarkable degree. The 159 coloured plates of mammals, birds and scenic areas cannot fail to evoke a warm response from every reader. It took him 7 years to film these species in the five continents. Understandably he could not afford too long over filming and studying a particular species. To take an example from India, he landed in Calcutta in early 1963 and went to the Kaziranga Sanctuary inevitably escorted by Mr. E. P. Gee. He makes some reference to the wild life of Kaziranga, to the rhinos, wild elephants, wild water buffaloes, swamp deer, and wild boars. There are two beautiful photographs of rhinoceros and one of wild elephants in the jungle. From Kaziranga he flew to Bombay and then to Gir Forest, and here again he managed to get beautiful photographs of lions at their kill. In the Gir Forest he also managed to track some Nilgai, and there is an attractive picture of a group walking through the jungle.

From the Gir the author went to the Rann of Kutch in search of wild ass: 'We had to drive far out into the brackish-water lake of the Little Rann, which at this time was completely dried out, before we found the wild asses. They looked small and rather indistinct as they stood in the shimmering heat on the treeless horizon. There was a herd of about thirty in the distance but we drew near quite fast as the floor of the dried out lake was as hard as cement. As we approached the asses started to move off, going farther out into the shimmering expanse of the lake basin. They appeared to be floating over the ground, their shapes reflected as in a mirage. As we chased after them, it developed into a race between animal and machine, the asses galloping away as fast as they could. All our photographs had to be taken through the side windows or windscreen of the vehicle, travelling at a speed of 25 to 35 miles per hour. Sometimes we managed to gain on them, sometimes they drew away. The wild asses withdrew deeper and deeper into their strange domain, in which there is unlimited space but not a single blade of grass. No one can follow them for long when they retreat into this area, and we soon realised, from the stuttering of the over-heated engine, that in the long run the asses were bound to win'.

This account of India is certainly interesting but not comprehensive by any means to cover the title of the book, 'The Last of the Wild'. There are so many other wild animals here which are threatened, including the tiger, the blackbuck, the swamp deer, the browantlered deer, the Kashmir stag, the Nilgiri tahr, the Nilgiri langur, the Great Indian bustard, and others. There is scope for a few years work in India alone.

Apart from the readable text, there is at the end, a species by species description of the animals illustrated, containing a scientific account of the distribution, the habits, and the status of animals and birds. This is a valuable part of the book for the serious naturalist.

Z. F.

3. READE, ELEPHANT HUNTER. By P. D. Stracey. pp. 173 (23×14 cm.), London 1967. Robert Hale. Price 25*s*. net.

Mr. Stracey likens Lovel Reade to Jim Corbett for intrepidity and knowledge of the jungle and he feels that if Reade has not achieved equal prominence it is mainly because he did not know influential men as Corbett did.

Lovel L. Reade, an Anglo-Khasi, served many years in the Assam Agricultural Service. His job was to induce the Nagas, Khasis, Lushais and other hill people to change over from their ancient and wasteful method of Jhum cultivation to terracing, crop rotation and the use of fertilisers. Reade does not appear to have had much success in introducing these modern ideas to the conservative hill people. He was, however, regarded a great benefactor by them because in the course of his work he shot elephants that had taken to pillaging their cultivated land. From 1928 when he shot his first elephant until 1967 when he shot his last (at the age of 76) he killed 220 elephants.

As is to be expected, in the many encounters that Reade had with these animals he had several narrow escapes from death. Elephant shooting on foot is certainly a dangerous pastime, especially since 'despite years of practice Reade could never move as quietly in the jungle as could his bare-footed companions' (p. 85).

Apart from his courage, Reade seems to have little in common with Corbett. The book does not tell us much about Reade and consequently he remains a shadowy character, a mere slayer of elephants. Stracey found him extremely modest and reticent, so reticent, in fact that the Author has had to fill a good part of the book with his own reminiscences.

READE, ELEPHANT HUNTER is a rather carelessly written, dreary account of elephants being shot, many messily. This is hardly surprising because '(Reade) had no precise idea of the elephant's brain. He certainly did not know the technique of finishing off an animal which is lying wounded, through the easy and certain back-of-the-brain shot, and his only recourse in such circumstances was to go on pumping in lead until death supervened' (pp. 51, 52).

About Reade's sportmanship: 'In this respect Reade did not differ from the rural gun man who has no scruples about killing animals—particularly 'meat' animals over salt licks and water holes, a practice unfortunately also prevalent with some so-called sportsmen'. (p. 111) and on p. 169 about hacking away at an elephant not yet dead. 'This extraordinary story, revolting in the callousness displayed by the villagers for starting to cut up an elephant which was not quite dead and on the part of Reade for allowing it, is a startling demonstration of how long and how deeply an elephant can remain stunned by a bullet lodged in the region of the brain'. A detached footnote to a gory episode and one wonders what is startling about the stunning effect of a bullet lodged in the region of the brain.

After being told all this it is impossible to arrive at any conclusion other than that Reade seems quite different from Corbett whose sensitive, vivid descriptions of the jungles and people of Kumaon, in addition to providing great enjoyment also create in the reader a warm affection for that very fine man.

A disappointing book from the Author of ELEPHANT GOLD which was more readable.

G. S. R.

4. BWANA GAME. By George Adamson. pp. 320 (22×14 cm.), with 67 illustrations. London, 1968. Collins & Harvill Press. Price 35*s*. net.

Lovers of nature and wild life, especially those who are conversant with the story of lioness Elsa and her cubs, will welcome this addition to the literature on wild life in Africa. The book is dedicated to 'the creatures of the wild', and throughout this autobiography runs a thread of love of wild creatures, particularly lions. The book contains the story of bringing up of Elsa and her cubs, and of the making of the film 'Born Free', without the use of questionable methods to obtain results from the animals.

The account of George Adamson's 23 years as a Game Warden in the northern Province of Kenya starts with a reference to Dholpur, a former princely State in Rajputana where the author's father was employed and was in charge of the State troops and the construction of a Railway. The second part of the story is entitled 'I find my vocation as a Game Warden' and narrates clearly how poaching has to be put down and how poachers, in order to provide furs for fashionable and 'civilised' women and civic dignitaries set up traps that cause untold suffering to thousands of animals. Although the author does not claim to have been a Shikari, he had, in course of his duties as Game Warden, to shoot dangerous animals including lions. He narrates graphically how, during his absence on leave when a substitute game warden was not appointed, poachers and illegal traders in Ivory, rhino horn and leopard skins, took full advantage of the situation. In this part, the reader gets a glimpse of the author's meeting with his future wife (Joy Adamson, author of Elsa books), the safaries they made together, VIPs and other guests, and the author's dealings with the tribe of Turkana and the Mau Mau.

The third part of the book describes how the lioness Elsa came into the lives of the author and his wife, how they kept in touch with Elsa's three cubs and how the film 'Born Free' was made.

The story of the lioness Elsa and her cubs has been told in Joy Adamson's three books, BORN FREE, LIVING FREE and FOR EVER FREE. These books have been translated into 33 languages and have sold several million copies. It is therefore odd to read that in 1959 when Mrs. Adamson offered the MS of BORN FREE to leading Publishers in London, it was turned down by all except the Harvill Press (in association with Collins). The author gives an interesting account of the production of the film and states that the script of the film was 'undeniably a fine piece of work, especially considering that the man who wrote it, as he himself admitted, knew nothing about lions'. Altogether 24 lions, lionesses and cubs were used in the making of this fine picture, and as stated earlier, no questionable methods were used to obtain results from the animals. It is obvious that the author was a father as well as a Warden to Elsa, the lioness, and the cubs, who were mothered by Joy Adamson. His 'behind the scene' story makes interesting reading.

The fourth and concluding part of the book describes how the pet lions were, with great care, returned to the wild at considerable trouble and expense. The author stresses how a National Park containing lions provides field for continuing scientific study of lion behaviour and the better understanding of our fellow wild creatures.

The author's love for wild life is exemplified in these words 'I cannot bear to see these highly intelligent and sensitive creatures treated as so much merchandise, shipped here and there over the world, mothers parted from offspring, brothers from sisters, friend from friend, regardless of their feelings and happiness. For What? To provide profit for dealers and entertainment for humanity. They too are living beings with emotions akin to ours. If I can bring happiness and fulfilment for a span into the life of a few and perhaps set the pattern for future rehabilitations, it will have been worthwhile'. The author concludes by stating that the proceeds of this book will go to aid his friends, the lions.

In an interesting narrative the author has avoided burdensome accounts of big game hunting and hair-breadth escapes and has succeeded in conveying to the readers a full picture of wild life. The author makes a forceful plea that it is the duty of man to protect what is at his mercy and to ensure survival of animals that contribute so much to man's knowledge and pleasure. He indicates how this duty can be discharged. The value of the book is enhanced by the excellent illustrations, some being in colour. The book clearly brings out the facts that no Government will ever be in a position to provide adequate funds for complete policing and warden's work in the forests and plains where wild life lives, that against a limited budget provision, the work of Game Wardens will always fall short of the goals to be achieved, that poachers will ever take their toll of wild life in the natural state and in game reserves, and that the only effective way to preserve wild life is to create suitable national parks from which all human inhabitants are excluded—except those who administer the park for the benefit of the animals (and except for a few tourists under strict supervision). The book has useful lessons for Indian conditions.

G. V. B.

5. PENGUINS. By Bernard Stonehouse. pp. 96 (20·5×21·5 cm.), 16 coloured and 54 black and white photographs, 21 line drawings. Arthur Barker Ltd., London, and Golden Press, New York, 1968. Price 21*s.*

The six chapters, Introducing Penguins, Penguins in general, Penguins in particular, Penguins' behaviour, Penguins at sea, and Penguins at home, are all profusely illustrated and the text, though limited, covers most of what is known about the eighteen species of this very interesting bird. They all live in the southern hemisphere and, though popularly associated with snowy wastes, several species are found as far north as the Galapagos on the equator and only three are restricted to areas of snow and ice. Their flightlessness renders them particularly vulnerable to predators on land, including man, and they are normally found in wild areas far from man.

Their incapacity to fly makes it possible for man to approach quite close to them, and their bipedal upright posture together with their social habits makes them particularly attractive to him as he sees himself caricatured among them. These circumstances have permitted their being photographed with the same clarity as man himself, and one or two species have been studied in detail.

This book is one of 'The World of Animals' series, edited by Winwood Reade, and if the others on the African elephant, the African lion, tigers etc. are as good as this every one of them must go into all libraries even remotely associated with natural history.

H. A.

6. SIX LEGGED SCIENCE. By Prof. Brian Hocking. pp. vii+199 (21×13 cm.). Cambridge, Massachusetts, 1967. Schenkman Publishing Co. Inc. Price $ 4·50.

This is a book on insects which is named by the author, light-heartedly, as 'Six Legged Science' meaning a book dealing with animals with six legs. Throughout the book the author has shown a great sense of humour, has argued the case of evolution and changes that were going on and has put forth arguments for his views, quoting verses from the classics, wherever possible. He has divided the insects into various groups and has discussed the life and habits of each group in simple language. He pleads with the reader to remain in harmony with his surroundings, especially the insects, which surround him the most. In a passage he says 'If the future of the world holds nothing else than more—many more —men and women, be they never so healthy and well fed, then it holds little indeed. Man needs a nobler objective than this. Perhaps he may find it through the study of nature, through sparing a thought for other animals besides himself, for the rat in the rat race'.

There are eighteen chapters, the first of which the author has named 'The Elephant Scientific Child' and gives a story in which a young elephant gets into trouble and shows how he would have got over it if he had six legs. On the basis of this he discusses evolutionary trends. In the next few chapters he discusses physiology and anatomy, the various senses, their evolution and uses, giving some line drawings which are original. The headings of chapters are also original and humorous, e.g., he calls the 8th chapter 'Verses to Order' and describes in it the various orders of insects quoting verses from various books and authors. Another chapter he calls 'Lord of the Dunghill' and describes flies, a third 'Bee's knees and corsages' dealing with bees and insects akin to it, 'Temperature of Sex' etc. etc. The line drawings are also original and significant. On the end papers he has recorded the tracks of walking insects, like the cockroach, the beetle *Tenebrio* etc. to show how each class of insects has its own peculiarity even in walking. A novel idea indeed. The book on the whole makes interesting and instructive reading. The references at the end are numerous and very useful.

N. T. N.

7. INSECTS : THEIR WAYS AND MEANS OF LIVING. By Robert Evans Snodgrass. pp. 362 (21·5×13·5 cm.). Numerous illustrations. New York, 1967. Dover Publications Inc. Paperback. Price $ 2.

This is a reprint, in handy form, of a book originally published thirty-seven years earlier. The author is a very distinguished scientist, whose careful and detailed anatomical studies on insects have influenced a generation of entomologists. The book, meant for laymen, differs in style and treatment from other popular books on entomology. No attempt is made to tell the reader about the entire insect world. Instead, particular insects are taken, their life-histories are described, and their anatomy as it affects their lives. A surprising amount of detail is given in an absolutely painless form. A great many biological principles come up in the course of these life-histories, for instance parasitism, hyperparasitism and predation, when discussing aphids. The illustrations by the author are exquisite. For anyone who has ever wondered what exactly goes on inside a cocoon there is a chapter called 'The Caterpillar and the Moth', which is about the best description of the physical processes involved that this reviewer has read. Very good value for the money.

R. R.

8. ELEMENTS OF ENTOMOLOGY. By Harold Oldroyd. pp. viii+312 (22×14 cm.). London, 1968. Wiedenfeld and Nicolson. Price 45*s*.

The book contains 23 chapters. The first chapter compares insects with other animals, Arthropoda in particular. Special features of insects are given. Second deals with the immature stages describing various ways of development. Chapters three to seven are devoted to the description of insect orders which have been grouped together according to their characteristics, habits and general behaviour. Very brief description of each order is given and their peculiarities are mentioned. They include also the evolutionary processes of insect life in relation to their environments. Mention is made of the number of species in each order to indicate the size of the order. This sort of arrangement of grouping various orders with similar characteristics into single chapters and explaining the gradual evolutionary processes going on in them, in a way that would appeal to a layman and scientist alike is a novel idea and very interesting. The eighth chapter describes the vision, the ninth sound and sound production and the tenth deals with the flight, describing the eyes and their visual power, the sound producing apparatus etc. The next two chapters deal with the adaptation of insects to their environment—terrestrial, aquatic etc. The two following chapters describe the feeding habits—herbivorous and carnivorous in fairly great detail. The social insects are dealt within the next three chapters, elucidating clearly what is meant by social habits or behaviour and how the social life began in insects. In these chapters, it is shown how even the social habits of each type of insect differ from those of others and the evolutionary aspect of this behaviour is discussed. While going through these chapters one cannot but admire the way the changes that have been going on even in small creatures like insects. The next chapter dealing with behaviour of insects is of great interest. It is almost a complimentary chapter to the previous three. The discussion regarding the reasoning power, reflexes, reactions to various stimuli both individual and communal are stimulating and thought-provoking. The next three chapters 19 to 21 are devoted to the relation between man, his surroundings and the insects and how they affect him. Short notes have been given in chapter 22 about the beneficial and useful insects and the last chapter deals with 'insects in the future' in which the author visualises the turn that the insect world may take due to the rapid changes that are taking place in the environment today and may come about tomorrow. Very interesting possibilities are mentioned and taking into consideration the general behaviour of the insects in response to their environment the author concludes that the insect of the future will make rapid physiological adaptations making few changes in form or shape, thus giving rise to new type of systematics using a numerical taxonomy and qualitative methods, perhaps entirely computarised.

The whole presentation makes absorbing reading full of information made lucid and thought-provoking. Besides this the bibliography at the end and the nicely made and printed 50 plates along with a number of line drawn figures, make the book a real asset to any library, general or scientific. As the author says at the outset, it is not a teaching manual but a book for background reading in addition to recommended textbooks. In short it depicts the wonders of insect life in a simple and coherent way which is not found in ordinary textbooks.

I would, however, like to draw attention to a few points. There is a discrepancy in the numbers of species of some of the orders as shown in the appendix (Table 3), and inside the book under various orders. Though the author says that there are no authentic figures available and mostly it is a guess work, there should be similarity between the figures given for the orders in the text and the appendix. For instance the number of lepidoptera species is 2,00,000 in the text and 1,00,000 in the appendix, similarly for coleoptera 2,75,000 and 2,20,000 respectively. Similar differences are seen in many other orders. It would be helpful if a scale is given under the figures of insects in the text so that the reader would understand the size of the insects.

N. T. N.

9. GENERAL ENTOMOLOGY. By M. S. Mani. pp. xii+501 (23×15 cm.). Calcutta/Bombay/New Delhi, 1968. Oxford & IBH Publishing Co. Price Rs. 18.

Textbooks rapidly become out of date, and new ones incorporating fresh developments are required. Dr. Mani has set out to do this, and in his preface addresses his book to students and research workers. The book is divided into two parts, General and Systematic. The general section is excellent; readable, comprehensible, and containing much new material. As one would expect, Embryology and Insect Distribution are especially well treated. One wonders, however, why the Indian sub-region, of major importance to many of Dr. Mani's potential readers, is dismissed in seven lines while the Chilean sub-region gets two pages. The value of the general section, and of the whole book, is impaired by the total absence of references, so that one cannot use it as a guide to further study.

The taxonomic part is less satisfactory than the general part. We are given a brief history of Insect Classification, but I could not find out whose classification Dr. Mani has chosen to follow. This is a pity, because it is not the generally accepted classification and I would have liked to find out who was responsible for the grouping of the orders into super-orders, and on what grounds. And why, contrary to general practice, have the more primitive Apterygota been discussed *after* the Pterygota? There is no reference to the classical textbook by Imms. Doubtless Dr. Mani has good reasons for the classification he has adopted, and a textbook is perhaps not the best place in which to explain them. This is where reference to the original work would have helped him. However openminded, the serious student is not likely to accept innovation unless he has access to the reason for it. The keys to the Diptera, the Brachycera, and the Schizophora would have been easier to follow if some of the pictures of insects had the wing-veins labelled. And why are so few Indian insects mentioned? Among the mantids for example, we are not told the name of a single Indian mantid. Insects from elsewhere in the world must be included for completeness, but the real need is for a textbook which quotes Indian insects as examples, so that Indian students know what they collect and study. An opportunity has been missed here.

There are some errors of fact. *Finlaya* and *Stegomyia* are sub-genera, not genera. Western and Eastern Equine Encephalitis are important human diseases as well as affecting horses. And surely figures 6 and 7 owe something to Snodgrass? We all remember laboriously copying something like this into our notebooks at college.

R. R.

10. ANIMALS OF EASTERN AUSTRALIA. By Stan & Kay Breeden. pp. 128 (22·5×28·5 cm.), with 197 black and white photographs and 15 coloured plates. London, 1967. Australasian Publishing Company, Sydney, in association with George G. Harrap & Co. Ltd. Price 50*s*.

As indicated in the sub-title, this is a photographic account of the mammals, reptiles, and amphibians of Eastern Australia. There is very little text but what there is is well chosen and, together with the captions to the photographs (in the mammal section, 12 pages of text are followed by 36 pages with 77 photographs), presents an exceptional amount of information.

Australia was separated from south-eastern Asia before the placental mammals had developed, and these are now only represented by bats, which were probably blown in by strong winds, and by rodents, which 'may have rafted across on floating debris'. Both these groups have developed into many different species in Australia, but have not prevented the survival of the egg-laying monotremes (which do not survive anywhere else in the world) and the marsupials which have developed into koalas, bandicoots, and carnivores, and possums and kangaroos of many kinds.

The sections on reptiles and amphibians do not perhaps contain the same amount of information, but the illustrations, particularly those in colour, are very good and together with the text offer much information, suggesting lines for research and observation in India. Several of the genera mentioned occur in India and we wonder when it will be possible to obtain such books for our fauna. For the moment we can only envy those who can look at books like this covering animals which they can see themselves.

H. A.

11. HANDBOOK OF THE BIRDS OF INDIA AND PAKISTAN, Vol. 1. By Sálim Ali and S. Dillon Ripley. pp. lviii+380 (16·7×24·7 cm.), 18 coloured plates. Bombay, 1968. Oxford University Press. Price Rs. 90.

The publication of the first volume of the HANDBOOK OF THE BIRDS OF INDIA AND PAKISTAN is an important event in the domain of Indian ornithology. The distinguished authors of the book have long been known for their extensive and intensive studies on the birds of India and the adjacent countries.

In connection with Ripley's SYNOPSIS I had observed in this *Journal* **59**:277 (1962) that due to 'accumulation of new data on the distribution, status, relationships, etc., of various Indian birds, and a rearrangement of different taxonomic categories' Stuart Baker's FAUNA OF BRITISH INDIA, BIRDS (2nd ed., 8 vols., 1922-30) was outmoded. And, the chief object of the HANDBOOK in the words of its authors, is not only to bring the FAUNA up to date but also to produce 'a work which combined strict scientific accuracy with non-technical language and popular appeal—concise accounts of life history and habits and, above all, good coloured illustrations supplemented by simple clues to field identification'.

The volume under review opens with the customary 'Introduction' chapter which gives a short history of the ornithology of the area concerned. This chapter is followed by one giving the contents of the various volumes of the book, and on the methods of taking measurements of birds. Then there are two short chapters giving lucid accounts on bird migration in India and on the zoogeography of the Indian subcontinent from the ornithological point of view. The descriptive accounts of the first 224 birds of Ripley's SYNOPSIS are then given in 369 pages, followed by 'References cited' and 'Index'. Every family and genus has been briefly defined, and keys to the genera, species or Indian forms given. The first name with full reference and type-locality of each form (species or subspecies) has been given, followed by its 'Local names', 'Size' (in relation to some common bird, e.g. Pigeon +), 'Field Characters', 'Status, distribution and habitat' (including extralimital range), and notes on migration, general habits, food, voice and calls, breeding, and museum diagnosis. Additional information not covered by these headings is given under a heading 'Miscellaneous'. Detailed feather by feather descriptions have been avoided.

The descriptive accounts of the various birds have been admirably written: they are lucid, flawless, and brief, yet in richness of factual material are encyclopædic. The reader expects a first-class piece of work from the pens of Drs. Sálim Ali and Dillon Ripley, and in this volume he will not be disappointed. A few minor discrepancies have caught the reviewer's eye, however.

The definitions of 'bhabar', 'duar', 'dun', and 'terai' as given on p. lv are not consistent with those used in geography (see, for example, Karan's NEPAL, Univ. Kentucky Press, 1960). There is sometimes a lack of agreement between what is said in the text and what is shown in the distribution maps which are such a valuable feature of the work. For example, the text states (p. 130) that the Barheaded Goose breeds eastward from 43°E. to Kamchatka (160°E.) but on the map the breeding range extends only to about 130°E. The Gadwall's breeding range, as shown in the map on p. 164, is similarly much less extensive than the text describes. But contrariwise the map on p. 209 shows the winter range of the Whiteheaded Stifftailed Duck extending east of Chittagong while the text implies that it is not likely to be found as far east as Calcutta. On maps of so small a scale misleading approximations cannot be avoided, but in the next edition it should be possible to resolve some discords.

Several artists have contributed to the coloured plates illustrating no fewer than 150 species and subspecies of birds. Some of the plates have been specially prepared for the HANDBOOK by Messrs C. J. F. Coombes, D. F. Harle and G. M. Henry; others have been reproduced from Smythies's THE BIRDS OF BURMA and Sálim Ali's THE BIRDS OF TRAVANCORE AND COCHIN and THE BIRDS OF SIKKIM. All of them are well-chosen and beautifully executed, but not well-reproduced. Reproduction of many of the plates is unsatisfactory. To this reviewer the coloured plates appear to constitute the only weakness of this volume.

The text is well printed, and the binding and general get-up are good. High rag-content paper and waterproof binding cloth have been used for the book to 'ensure good wearing qualities and resistance to insect attack'. I wonder if special glue has also been used to make the book effectively insect-resistant.

Notwithstanding the minor discrepancies indicated above, and occasional inconsistency in the style of citing references in the text, it can be stated without exaggeration that the HANDBOOK is a monumental work of scientific knowledge, and an important landmark in Indian ornithology. It is bound to remain an indispensable, standard publication for all serious students of ornithology of the Oriental Region.

BISWAMOY BISWAS

Miscellaneous Notes

1. RINDERPEST IN MUDUMALAI AND BANDIPUR

There has been a very serious outbreak of rinderpest in the jungles in low country to the north and north-west of the main Nilgiri Range, particularly in the Mudumalai and Bandipur Wild Life Sanctuaries.

The disease was first noticed among the valuable domestic buffaloes which are grazed in the Singara, Moyar and Sigur Reserved Forests east of Mudumalai. Over 300 of these large, healthy, aggressive animals which are totally unlike the buffaloes of the plains were wiped out in less than 2 months from the middle of July 1968. Curiously, hardly any of the horde of decrepit cattle in the area were affected.

From August onwards the gaur began to fall victims to the disease. The 'cattle plague' swept through Mudumalai in August, September and part of October with disastrous results. In Mudumalai alone over 100 carcasses were found near water and by the road side. How many more succumbed to the disease in the interior, no one would know.

I believe the disease claimed several victims among the gaur in adjoining Bandipur.

A few sambar were also found dead in Mudumalai. From October up to the third week of November 1968, instances of death among chital and more casualties among sambar was reported. Some wild pigs were also found dead. The cause of these deaths has not so far been established.

All this waste of valuable wild life points to the necessity of organising our wild life preservation efforts in our sanctuaries, on a proper scientific basis, to meet emergencies of this nature.

KING AND PATRIDGE,
SOLICITORS,
OOTACAMUND,
December 3, 1968.

E. R. C. DAVIDAR

2. FOOD HABITS OF THE HIMALAYAN BLACK BEAR (*SELENARCTOS THIBETANUS*) IN THE DACHIGAM SANCTUARY, KASHMIR

Jerdon (1874), Stockley (1936), and others have commented on the food habits of the Himalayan black bear (*Selenarctos thibetanus*) in general terms. Prater (1965), for example, wrote: 'Food varies with season. In summer they live largely on wild fruits and berries and raid orchards for pears, apricots, and nuts of various kinds . . . This is the season when honey is to be had . . . Fields of ripening corn or maize are raided in the autumn. Insects, termites, and the larvae of beetles provide variety to this diet. It is the most carnivorous of the bears, and many living near villages kill sheep and goats . .' . However, detailed data on food habits for a particular area are not available. While studying the hangul (*Cervus elaphus hanglu*) in the Dachigam Sanctuary, which lies about 20 km. from the city of Srinagar, I encountered black bears on 17 occasions between October 6 and 21, 1968, and made observations on their feeding behaviour. In addition, bear droppings were examined to provide quantitative information on food habits.

All observations were made in the lower part of the Dachigam valley along 13 km. of the Dagwan River. The bears confined themselves primarily to the forested floor and lower slopes of the narrow valley between the altitudes of about 1750 and 2000 m. The deciduous forest consists predominantly of mulberry trees (*Morus* sp.), oak (*Quercus* sp.), willow (*Salix* sp.), and walnut (*Juglans regia*) as well as *Celtis australis*, *Rhus cotinus*, *Populus* sp. and others. Undergrowth is dense with such shrubs as *Rubus* sp., *Rosa* sp., *Indigofera geradiana*, and *Parrotia jacquemontiana* common.

Food habits: Eighty-two droppings were examined to determine what the bears had eaten (Table). The most important foods were *Celtis australis* (40·2%), walnuts (32·9%), and acorns (12·1%). Although the figures are expressed as frequency of occurrence, they also give an indication of volume because most droppings contained the remnants of only one food item. In early October, walnuts and acorns were prominent in the diet, but by late October, when these two species had been largely eaten up, the bears switched to *Celtis*, a pea-sized fruit ripening at that time. Scattered apricot and apple trees and grape vines grow in the forest and bears ate the fruits. Maize was obtained in the fields bordering the sanctuary. Only one dropping contained the fruits of wild rose even though they were abundant. Of the 9 kinds of fruit eaten, 5 are not indigenous to the area. Their frequency of occurrence in the droppings was 31·4% (Table), indicating that these introduced species contributed substantially to the diet of the bears.

TABLE

FREQUENCY OF OCCURRENCE OF FOOD ITEMS IN 82 BLACK BEAR DROPPINGS

Food items	Frequency of occurrence (in per cent)
Celtis australis	40·2
Walnut	32·9
*Oak	12·1
*Grape	8·5
Zizyphus vulgaris	4·8
*Apple	4·8
*Maize	3·6
*Apricot	2·4
Rose	1·2
Feather	1·2
Hair	1·2
Wasp	1·2

*Introduced or domesticated plants.

Animal matter was uncommon in the droppings (3·6%). One contained about 20 wasps, a second several unidentified feathers, and a third a number of brown hairs possibly belonging to hangul or cow. H. Nedou, a sportsman in Srinagar, told me that he once saw a black bear eating a hangul young, and the predilection of bears for livestock has been repeatedly noted (Stockley 1936; Prater 1965). The bears in the lower Dachigam Sanctuary do not kill livestock according to the Forest Department. It is possible that the hair in the dropping represented carrion.

The results from the analysis of the droppings were in general confirmed by observing bears directly. Of 16 feeding animals seen, 13 were eating *Celtis*, two were in walnut trees, and one was picking acorns off the ground.

These data on food habits apply only to October. The same species are probably eaten also in September and November but of different amounts. In July and August, maize and mulberry are commonly taken, according to the local forest staff, and in May and June, before fruits ripen, grass and leaves are said to form the main part of the diet. I found two *Pinus excelsa* trees whose bark had been heavily clawed several months previously, and I was told that bears eat the resin. Black bears are largely inactive during the winter from December to April.

Feeding behaviour: Black bears obtained much of their fruit by climbing into trees, sometimes into the upper branches 10 or more metres above ground. After choosing a horizontal branch or a fork on which to lie, sit, squat, or stand, they reached out with their forepaws and pulled fruit-bearing twigs toward them. Small twigs simply were hooked with the long, curved claws of one paw and broken inward, but large branches required more effort. One bear bit repeatedly into the base of a branch, then bent it inward with a paw until it snapped and the fruit could be reached. Another bear broke a branch by pulling with both paws and then with its mouth as well. Afterward it bent twig after twig toward its face and plucked the *Celtis* berries with the lips, the usual method of detaching fruit. In one instance, a bear broke several branches in a walnut tree, but most nuts fell to the ground. The animal descended, ate the fallen fruit, then climbed back up and bent in several more branches. Virtually all walnut, oak and *Celtis* trees had several broken branches, attesting to the heavy use of these species by bears in the sanctuary.

Although Prater (1965) stated that black bears are primarily nocturnal, those in the Dachigam Sanctuary were frequently active during the day. Bears were seen feeding 4 times between 06·00 and 09·00 hours, twice between 09·00 and 12·00 hours, 4 times between 12·00 and 15·00 hours, and 6 times between 15·00 and 18·00 hours.

On one occasion a feeding bear broke several branches inward while standing in the fork of a *Celtis* tree. Each discarded branch was pushed and trampled into the fork, forming a crude platform which resembled the sleeping nests of the great apes and the Malayan bear (*Helarctos malayanus*) as reported by Schaller (1964). After the bear finished eating, it rested on this platform in the morning sun. Novikov (1962) noted that a feeding bear 'drags down and breaks numerous branches, which gave rise to the assumption that the black bear builds special "arbors" for resting'. If black bears ever build nests solely for resting, or only inadvertently in the course of feeding, is not certain but observations by Tun Yin (1954) suggest they may do so.

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SERENGETI RESEARCH INSTITUTE,
BOX 3134, ARUSHA, GEORGE B. SCHALLER
TANZANIA,
November 3, 1968.

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3. NOTES ON THE INTER-BREEDING BETWEEN DOMESTIC AND WILD BUFFALO IN UPPER ASSAM

A number of interesting observations have been made in the past referring to Lower Assam and other parts of India, on the use made for breeding by the local village people, of the solitary wild bull buffalo that leaves the jungle temporarily at certain times of the year to join the domestic herds grazing in or near the jungle. There are varying opinions as to whether the wild bull and its subsequent inter-breeding with domestic animals is an advantage or otherwise, and likewise whether the bull is one that has been driven out of a wild herd by a stronger bull or has left the jungle of its own free will. During the past five years I have been able to devote considerable time to the study of this subject as applicable to this extreme corner of Assam, and in living close to the edge of the jungle that forms the local habitat of the wild buffalo, it has been possible for me to investigate personally instances of wild bulls joining the near-by village herds.

STUDY AREA

My observations apply to the area that may be termed Upper Assam, comprising the south bank of the Brahmaputra north and east of Dibrugarh, to Saikhowa on the Lohit River in the extreme north-east. The northern boundary being the river, and the southern being National Highway 37. I refer in particular to the village areas immediately adjacent to the Dibrugarh and Saikhowa Reserved Forests and their adjoining unclassified jungles; the entire area covering approximately 150 square miles. These areas are low lying and subject to frequent flooding during the rains and consist of large expanses of dense cane and reed jungle, interspersed with 'bheels' which remain flooded throughout the year. These jungles offer both grazing and cover to the wild buffalo that abound in them.

The local villagers are mainly Morans, ex-Tea Garden workers and Miris, many of whom keep domestic buffaloes numbering from one to possibly ten per household. These people have found over the years that it is quite impossible for them, without special precautions and considerable inconvenience, to keep their own domestic bull buffaloes for breeding or even ploughing purposes, as such animals will certainly be killed by the visiting wild bulls that inevitably appear every year from the near-by jungle. They have, however, discovered through force of circumstance that such wild bulls fill the role of 'sire' to the village herds most admirably, with only certain inconvenient disadvantages which are ultimately outweighed by the advantages.

A most important factor that must be borne in mind when considering this subject in this particular locality, is that for many years now the people have of necessity been entirely dependent on the wild bull buffaloes for breeding. In consequence the domestic buffaloes of the locality show very definite traces of wild blood and are more like the wild buffalo in appearance than the purely domestic animal.

The Wild Bull Buffalo

It has been suggested that the solitary wild bull that visits domestic herds is a young one that has been driven out of a wild herd by a stronger bull. This I am sure may certainly be so in some cases but need not necessarily apply generally. The bull in the majority of instances recorded by me, has proved to be a middle-aged one but only in a very definite minority of cases has the bull been young. I have recorded only one instance of the visiting wild bull being an old animal, and then it was such a fine specimen that it was difficult to imagine its having been chased out of any wild herd by anything but the most powerful of rivals.

In this area the wild buffalo would appear to live in herds of from five to fifteen animals. Due to the inaccessibility of this area during the rains my observations have been made mainly during the cold weather, during which on two occasions I have noted more than one mature bull apparently living quite happily together within such a herd. The cold weather covers the time at which domestic cows certainly come into season, and should this also be the case with wild cows the fact that more than one bull has been seen during such times with wild herds, would tend to contradict the theory that weaker bulls are driven out by stronger animals.

Wild bulls first start appearing in the vicinity of the villages at the time when paddy is well established with heads just beginning to form, and at such times they wreak havoc in the fields and would appear to come out of the jungle primarily to feed. While on such forays into cultivation wild bulls can hardly avoid contact with domestic herds as it is at this time that the herds are first taken out to graze at the jungle edges. The bull at such times finds itself alone and unrivalled amongst considerable numbers of domestic cows, the advantages of remaining either with or near them being apparent. In view of these considerations I am of the opinion that although some of these solitary bulls may well have been driven out of wild herds by stronger bulls, the majority have left the jungle of their own free will. Quite apart from my own conclusions this view has been put to me by a number of local buffalo owners.

I have found that usually only a single bull will appear at a time in any one particular place, but I have found it quite common for two bulls to be visiting villages simultaneously a mile or two apart. On only one occasion have I recorded two wild bulls appearing together at the same place. This occurred at the end of the cold weather when the domestic cows were grazing in household groups in an extensive area of paddy fields between a village and the jungle. On this occasion I saw the two bulls appear simultaneously from the jungle about twenty or thirty yards apart, quite obviously in company and well aware of each other's presence. Each bull joined a small group of domestic cows well within sight of each other and remained so until the evening when they were chased off by the herd boys. On coming together again at the jungle edge a fight ensued, and although I did not personally witness it, I found ample evidence of it when called to the scene almost immediately afterwards. After this altercation it was noted that only one bull continued to come out of the jungle at this point to visit the village herds, while the other was found some days later to be visiting a herd some two miles away.

Behaviour of the Wild Bull

It would appear that the visiting wild bulls are unable to tolerate even very young bull calves with any village herd that they may join. I have evidence this year of one such calf having been killed and two others that would surely have suffered the same fate but for the timely intervention of the herdsmen. On occasions a villager has attempted to keep a particularly good bull calf by grazing it away from the main herds. Sooner or later it has been necessary to graze such an animal on the jungle edge with the main herds when grazing elsewhere has become scarce, and the result has been that the young domestic bull has been very roughly treated by any wild bull that has appeared. For this reason young bull calves are usually sold, outside this area, at an age at which they become able to fend for themselves.

During the cold weather the grazing of the domestic herds falls into two distinct phases. The first covers a period from mid November to mid or late January when they are sent out with herdsmen to graze the jungle edge well away from the still standing rice crop. At this time a group of buffalo owners appoint a herdsman, frequently one of themselves assisted by two or three younger men or boys, who take the animals out to the jungle edge where a camp (kuti) is established. From this camp the buffalo are turned out to graze early each morning and returned each evening at about 4 p.m. The second phase covers a period from mid or late January until the end of March or early April. During this time the village buffalo are turned out daily to graze at will on the stubble in the paddy fields adjoining the villages or on the jungle edge, being returned each evening to their pickets at the homes of their respective owners.

During the first period the wild bulls join the herds early in the morning and remain with them, often close to some 'in season' cow until the herdsmen appear at about 4 p.m. to drive the cows back to the camp for the night. I have found that at this time the bull will either move a short distance into the jungle until the herd has been assembled, and then follow close behind and rejoin the cows once they have been tethered; or remain in the jungle until 8 or 9 p.m., possibly paying a quick visit to the near-by rice fields prior to rejoining his new found mistresses at the camp, where he stays until just before dawn at which time he will retire into the jungle to start the whole cycle again.

During the second period when cows are being turned out to graze at will and returned each evening to their owners' homes, the wild bull again appears from the jungle early each morning and grazes with the herd the whole day even though they may wander back into populated areas. In the evening when collecting their buffalo the herdsmen drive off the wild bull which normally leaves without too much trouble, but will almost certainly return to the picket lines soon after dusk even though they may be situated well within the confines of the village. This is particularly so if during the day the bull has been keeping the company of any particular 'in season' cow.

It is at this time that one of the disadvantages of using the wild bull becomes apparent. When it finds an 'in season' cow it quite often retires with the cow into the jungle so necessitating the herdsmen going in search of her in order to return her to the herd in the evening. This often results in the two being disturbed, invariably upsetting the bull which will almost certainly attempt to chase off intruders, who if caught risk losing their lives. The herdsmen have learned that in such cases they must despite the risks involved, go in search of cows abducted in this way as their having failed to do so in the past has resulted on occasions in the cow 'going wild' and being lost.

During the night whether in a 'kuti' on the edge of the jungle or in the village picket lines, the bull remains quiet but alert in the midst of the cows sometimes standing, sometimes resting on the ground. The herdsmen at intervals throughout the night walk round their charges to see that all is well and providing they keep well clear of any cow to which the bull may be paying particular attention he will not normally become restive. I have had personal experience of this behaviour when staying with herdsmen in 'jungle kutis' where a small fire is kept burning most of the night and the herdsmen talk and even sing without unduly disturbing the bull. On one such occasion I was able to approach to within fifteen paces of a bull, shining a torch on him all the time without apparently alarming him unduly. Likewise milkers are not under normal circumstances harmed unless they get too close to a cow that may currently be enjoying the bull's favour.

Of all the instances of wild bulls appearing that I have investigated only two bulls have shown any particular aggressiveness beyond the circumstances that I have related. The general attitude of the herdsmen and milkers is that one can never be sure what a wild bull may do in any particular situation and so as they have absolutely no choice in whether the bull comes or goes, all are treated with the utmost respect which to an outsider might appear to be complete nonchalance.

Seasons of the Domestic Cow and times at which Wild Bulls appear

Until the 16th August this year I had no evidence at all of wild bulls joining village herds or even appearing in the vicinity of the villages during the rains. On this date, however, in response to a summons from a near-by village, where wild bulls certainly appear during the cold weather, I went out to find that a young wild bull was coming right into the village early each morning and remaining there from about two to four a.m. In following him in his movements during this period I found that he visited, but made no attempt to enter almost all the tethering points of domestic buffaloes in the village. This was, however, only done after a period of feeding in the cultivations around the houses. The visits of this animal continued for a week and then ceased as abruptly as they had started. This behaviour I feel is very much an exception and would offer two reasons for bulls not usually leaving the jungle during the rains.

Firstly, from June to the end of September movement over even short distances for either man or beast in these areas is made very difficult by the heavy flooding of what is already most difficult terrain. The overflowing rivers merge so doubling the depth and surface area of the bheels and also form large areas of temporary swamp in the very lowlying reed beds between the jungle and the villages.

Secondly, the domestic buffalo comes into season during the cold weather, mainly in January and February when the floods have subsided and the rice crop offers ready grazing to any wild buffalo that may come out of the jungle.

The gestation period of the domestic buffalo is ten months and calves are therefore born during the following cold weather.

Domestic Cow served by a Wild Bull

It is interesting to note that observations made in the past have revealed that in other parts of the country many domestic cows served by wild bulls have failed to conceive and of those that have conceived a considerable proportion have died at the time of calving. I can find no evidence of this at all either from the local buffalo owners or from my own observations in this area. I find that the majority of domestic cows have conceived, the only ones not having done so being the smaller and weaker cows which are often new additions to the herd brought in from other areas. These likewise would seem to have been the only ones injured at the time of serving. I attribute this lack of fatalities at the time of service and calving, quite contrary to what has been noted in other regions, directly to the fact that the cows of this particular area after many years of interbreeding with wild buffalo, are much better suited to mate with the wild bull than the purely domestic animal.

Offspring of the Wild Bull and the Domestic Cow

The majority of calves by wild bulls survive but where such a calf has died it has not usually been at birth but anything up to ten days later. I have recorded only three instances of such deaths and the only conclusion I have been able to reach is that the mother in all cases has been unable to provide sufficient milk for the calf. Almost without exception calves by wild bulls are much larger and more sturdy than their purely domestic counterparts.

The differences between half wild and purely domestic stock are quite apparent. The former are considerably heavier in build and better looking than the latter. They tend to have much larger and more upright horns and shorter more powerful necks. The thicker chest and shorter more powerful legs, with hooves that are bigger and more rounded are quite distinctive as are the white markings on the legs and chest.

Opinions vary on the milk producing potential of the cross bred cow. The average yield of the purely domestic cow in this area is two to two and a half seers of milk per day. This is approximately three quarters of a seer more than is produced daily by the cow of mixed descent on the grazing available locally. However, there is no doubt that the cross bred animal can and will produce up to one seer more per day than the purely domestic cow if it is ranged freely in the jungle on really good grazing.

Local buffalo owners claim that cows of mixed descent do tend to give more trouble at the time of calving than their domestic sisters and are also very aggressively possessive of their offspring once born. They can also be expected to give a certain amount of trouble at the time of milking after the birth of the first calf, but seldom after that.

The male calves of mixed blood are usually sold when quite young and are much sought after by buffalo owners in areas to which wild bulls do not have access. They may be expected to realise a somewhat better price than a pure domestic bull calf as they are invariably handsomer than the latter and make an equally good if not better plough animal.

From the very few occasions that I have been able to observe the bull of mixed blood there can be no doubt that they are somewhat more aggressive than the domestic bull. They are rather more difficult to deal with than the latter but not to an extent that they cannot be managed by the herdsmen. On the one occasion that I was present when such a bull was with a herd that was approached by a wild bull, the former showed considerable spirit in advancing to meet the intruder. It was not reluctant to fight but when the inevitable clash came it was just no match for the wild bull which only made off when a gun was fired.

I have been told by the local people that the animal that they fear most is the bull of mixed descent born in the jungle to a domestic cow that has 'gone wild' having been abducted as described earlier by a wild bull. Should such an animal leave the jungle to visit village herds it proves an absolute menace in every way. It is said to have little or no fear of man and is wilfully destructive and completely unpredictable in its actions. I have not, however, as yet personally come across such an animal.

I do not wish to give the impression that the solitary wild bull in this area is or can be treated with anything but the utmost respect as this is certainly not so. The villagers feel that the visits of such bulls are inevitable and although there are certain disadvantages in using them for breeding purposes these are ultimately outweighed by the advantages. The people have through years of experience come to know what to expect of the wild bull and act accordingly, making the very best of circumstances over which they have no control.

TIPPUK TEA ESTATE,
P. O. TALAP, R. W. SCOTT
ASSAM,
November 19, 1968.

4. FURTHER EXTENSION OF RECORDED SOUTHERN RANGE OF LITTLE CRAKE, *PORZANA PARVA* (SCOPOLI)

In the *Journal* (**65**: 217-218), Sálim Ali and one of us (H.A.) referred to an overlooked specimen of the Little Crake, *Porzana parva* (Scopoli), obtained in Bombay many years ago, which extended the currently accepted southward limit of this species. In the course of cataloguing the Bombay collection, we have found another specimen (No. 13880), obtained by T. R. Bell at Karwar, N. Kanara (no date), which takes the limit further south. This was listed as *P. pusilla* and appears to have been overlooked in earlier literature.

The key in the INDIAN HANDBOOK (**2**: 159) reads:—

Breast immaculate; wing under 110 mm.

Outer edge of primary brown; wing over 94 mm. *P. parva.*

Outer edge of primary white; wing under 93 mm. *P. pusilla.*

The white edge to the wing is more pronounced in *pusilla* but in both the present specimen and another female *parva* from Mesopotamia, the outer edge is white and, in the absence of a specimen of *pusilla* for comparison, may well be placed in that group.

In the material available (7 *parva*, 20 *pusilla*), the wing measurements of the males are perhaps exclusive (2 *parva* 101, 104 cf. 13 *pusilla* 88-96 av. 90·25) but the difference between female *parva* (97, 97, 99, 100) and the larger juvenile males of *pusilla* (88-95 av. 89) is marginal, and very likely to overlap in a larger series. The underparts of ♀ *parva*, however, are uniformly buff-coloured while most *pusilla* are whitish with varying amounts of brown (and grey) on the sides of the breast. A constant difference appears to be the colour of the head—uniformly brown in both sexes in *parva*, and marked with black in *pusilla*. Mr. D. Goodwin of the British Museum (N.H.), who has very kindly confirmed our identification, agrees that this is a good character for differentiating between the species.

75, ABDUL REHMAN STREET,
BOMBAY-3, HUMAYUN ABDULALI

BOMBAY NATURAL HISTORY SOCIETY,
BOMBAY-1, SHANTA NAIR
March 12, 1969.

5. THE NAME OF THE JUNGLE BABBLER *TURDOIDES STRIATUS* (AVES) FROM ORISSA

While working on the ranges of the babblers for a forthcoming volume of the HANDBOOK, Dr. Sálim Ali pointed out to me that he had collected the Jungle Babbler in Orissa which looked very different from nominate *striatus* but that his specimens had never been critically examined. In their work on the Jungle Babbler (called by them, *Turdoides somervillei* and races), Whistler & Kinnear (1936, *J.*

Bombay nat. Hist. Soc. **35**: 737-739) had assigned this range to *terricolor*. In the SYNOPSIS (1961, p. 377, form No. 1265), I assigned the range of *Turdoides striatus striatus* (Dumont) [*terricolor* is a synonym], to Orissa, not having seen specimens, and following Whistler, Kinnear and subsequent authors. Dr. Sálim Ali kindly sent his four specimens to Washington, where in series, their rufescent colour and unstreaked underparts make them stand out immediately from any other known population. Fortunately, Jerdon (1847, ILLUSTRATIONS TO INDIAN ORNITHOLOGY, text to Pl. XIX) had noticed that a specimen from Goomsoor was more rufescent than others and wrote that should it prove to be distinct, he would propose the name *orissae*. It is evident, therefore, that the birds in question should be called *Turdoides striatus orissae* (Jerdon). In view of the foregoing, it seems relevant at this time to append a more up-to-date and complete description of this subspecies to supplement Jerdon's adequate but rather scanty diagnosis.

Turdoides striatus orissae: More rufescent throughout than any other subspecies of *T. striatus*. Resembles most *somervillei* of coastal Maharashtra and Gujarat, particularly those specimens from the latter region grading towards *sindianus*; which, however, are distinguished by their buff rump, paler than the back. This population is separated from the range of *somervillei* by the grey *orientalis* of the Deccan plateau which is darker and has the breast heavily streaked. From *malabaricus* of Kerala, and the south-west of Mysore it differs by being more rufescent above, by having the throat much paler, and by lacking the heavy streaking on the breast. *T. s. striatus* and *sindianus* are much greyer and paler. It is worthwhile noting that these birds from coastal Orissa resemble most the two rufescent brown-tailed subspecies *malabaricus* and *somervillei* from the west coast of the Peninsula. A key to these subspecies will appear in Volume **6** of the HANDBOOK.

Holotype: ♂ ad. No. 15956, Bombay Natural History Society, collected by Sálim Ali on 10 December 1949 at Barkot, Sambalpur district, Orissa.

Measurements: Wing 103, tail 102, bill (from skull) 25; tarsus 35 mm.

Range: Orissa east of the Ghats, and perhaps north-eastern Andhra Pradesh south to the Godavari River delta.

SMITHSONIAN INSTITUTION,
WASHINGTON, D. C. 20560,
April 22, 1969.

S. DILLON RIPLEY

6. AN ALBINO WOOD SANDPIPER (*TRINGA GLAREOLA*)

Among the many waders which visit us on the River Aji just behind the Central Jail is a very unusual bird—a pure white, Spotted Sandpiper. It is not a complete albino because its bill and iris are black and legs greenish instead of pink.

This spot is unique for waders, for seated comfortably on a broad rock, a birdwatcher can see a large variety of waders all together, a not to be underrated advantage when one considers the confusing appearance of these birds. On a normal day in winter all forms of sandpipers may be in a binocular's field—*Tringa glareola, T. ochropus, T. hypoleucos, T. totanus, T. erythropus* and *T. stagnatalis*! In addition there will be Little Stints (*Calidris minutus*), Temminck's Stint (*Calidris temminckii*), Ruff (*Philomachus pugnax*) and Black-winged Stilts (*Himantopus himantopus*). On occasions Curlew Sandpipers (*Calidris testacea*) and Dunlin (*C. alpina*) jostle among the rest providing ideal possibilities of noting identity contrasts. Besides these, always present are other water-side birds like plovers, crakes, ducks, grebes, terns, wagtails, etc., but the attraction of the place, not withstanding the smell of the effluent polluting the water, are the winter waders.

RAJKUMAR COLLEGE,
RAJKOT,
GUJARAT,
December 12, 1968.

K. S. LAVKUMAR

7. UNUSUAL NESTING SITE OF THE PURPLE SUNBIRD, *NECTARINIA ASIATICA* (LATHAM)

On the afternoon of 22 May, 1968, I noticed a female Purple Sunbird, *Nectarinia asiatica* (Latham) clinging on to a nightgown hung on the clothes-line just outside our living room. After pecking at the fabric between two folds she flew away. A closer look revealed that she was apparently trying to build a nest and I found a collection of cobwebs with three small egg cocoons. It was late that day to make closer observations and in the night my wife removed the gown.

The following morning, before starting for work, I put an old canvas (the type used on deck chairs) on the clothes-line, exactly in the place where the gown had been, and arranged it in such a way as to leave two well-formed folds. In between the folds I made a fairly deep pocket using half a dozen pins. At 5 p.m. the same day I returned home to find that the female sunbird had started a nest in the pocket using the usual material. She stuffed the inside profusely with cotton collected from a nearby 'Kapok' (*Bombax ceiba*) tree. On the 1st and 2nd June two eggs were laid in the pocket and the hen started sitting. The nest was in the centre of the clothes-line and hardly two feet above the ground. Late one afternoon the canvas was blown to the very end of the string but without any ill effect. The bird was quite tame and did not pay heed to any disturbance.

The two eggs were successfully hatched on the morning of the 14th June and only then the cock started paying frequent visits to the nest. Before this he was rarely seen near the nest and spent his time on two selected perches 25-30 yards from the site, which gave a commanding view of the place. However, he never failed to send out a warning to the hen whenever anybody came too close to the nest. Nevertheless she took little or no notice of these warnings and paid no attention to our presence. Once I brushed against the nest accidentally and she was not alarmed, but if I looked in at her from close quarters she got excited and alarmed. At night the hen sat very close, with her beak drawn in, whilst the chicks faced away from the entrance.

After the brood was a few days old the cock played a prominent part in feeding them and appeared to be very attached to them. Every time he fed the young he removed a portion of the droppings inside for disposal.

By about the 5th day the young started to fledge and were completely fledged by about the 11th day after their birth. They were coloured exactly like the adult female, perhaps a little darker on the upper parts, but the yellow on the chin and upper breast were a bright yellow in comparison. During the heat of the day the young spent long hours at the entrance looking out.

On 27 June I took one of the chicks out but it soon freed itself and flew. It was with some difficulty that I recaptured it and put it back in the nest. Of its own accord it flew away once more and I had to recapture it and replace it in the nest again.

Early on the following morning the same chick had left the nest without our noticing it and when my nephew walked up to investigate, the other chick too left the nest and flew off into the nearby scrub.

During the next couple of days the family remained in and around our garden, and the peeping call of the young could be heard off and on throughout the day. On the 10th of July I noticed that the young were as big as the mother.

ELECTRICAL ENGINEER'S OFFICE,
RIVER VALLEYS DEVELOPMENT BOARD,
AMPARAI, CEYLON,
September 27, 1968.

K. G. H. MUNIDASA

8. A SURVEY OF DIGENETIC TREMATODES FROM BIRDS IN THE VARANASI DISTRICT, INDIA

INTRODUCTION

India has a rich bird fauna, and a correspondingly rich fauna of digenetic trematodes which infest them. Out of 29 families of these flukes reported to infect birds, 21 families are represented in India. The family Thapariellidae (Srivastava 1955) and the sub-family Basantisiinae, Yamaguti (1958) are endemic. The following genera are endemic. *Basantisia* Pande, 1938; *Chinhuta* Lal, 1937; *Neoalaria* Lal, 1939; *Neodiplostomoides* Vidyarthi, 1938; *Procrassiphiala* Verma, 1936; *Pseudoechinochasmus* Verma, 1936; *Psilocollaris* Singh, 1954; *Psilorchis* Thapar & Lal, 1935; *Subuyulifer* Dubois, 1952; and *Thapariella* Srivastava, 1955.

No systematic survey appears to have been done among birds in India, to determine natural infestation by parasites. This paper is a preliminary report of a survey conducted on more than 300 birds.

MATERIAL AND METHOD

The survey was conducted in the district of Varanasi (U.P.) during the year 1962-63 when birds, representing 20 families and 35 species, were examined. All parasites were collected from the intestines, except *Tracheophilus sisowi acirratus* n. var. which was found in the trachea. The parasites were collected by placing different parts of the host body in separate troughs containing 0·5% methane. In this media the parasites left the host's body within 3 to 5 minutes. Only some interesting forms of parasites were studied in detail, while others were identified upto the genus.

OBSERVATIONS

Some birds appeared immune to trematode infection, some had one species of fluke, while others harboured several species. Some trematodes occurred in greater frequency in a number of avian hosts while some were rare or host specific. The avian hosts examined are listed in the table.

TABLE

Hosts	No. Examined	Trematodes
PELECANIDAE		
Pelecanus philippensis Gmelin	6	*Prosthogonimus* sp.
		Opisthorchis sp.
PHALACROCORACIDAE		
Anhinga rufa melanogaster Pennant	23	*Petasiger yamagutii* Nigam, 1944.
		Tylodelphys sp.
		Apatemon casarcus Vidyarthi, 1937.
		Opisthorchis sp.
		Cyathocotyle indica Mehra, 1943.
ARDEIDAE		
Ardeola grayii (Sykes)	7	*Echinochasmus bagulai* Verma, 1936.
		Strigea sp.
Bubulcus ibis (Linnaeus)	10	*Echinostoma* sp.
		Apharyngostrigea egretii Verma, 1936.
Nycticorax nycticorax (Linnaeus)	12	*Echinostoma bagulai* Verma, 1936.
		Apharyngostrigea sp.
CICONIIDAE		
Ibis leucocephalus (Pennant)	11	*Cardiocephalus* sp.
Anastomus oscitans (Boddaert)	12	*Chaunocephalus similiferox* Verma, 1936.
		Patagifer sp.
		Echinostoma sp.
		Strigea sp.
Ciconia episcopus (Boddaert)	8	Negative for trematodes.
Xenorhynchus asiaticus asiaticus (Latham)	16	*Tylodelphys* sp.
		Cathaemsia dollfusi Travassos, 1951.
THRESKIORNITHIDAE		
Threskiornis melanocephala (Latham)	9	Negative for trematodes.
Pseudibis papillosa (Temminck)	44	*Patagifer wesleyi* Verma, 1936.
		Echinochasmus sp.
		Notocotylus sp.
		Parastrigea sp.
		Cotylurus orientalis Vidyarthi, 1937.
ANATIDAE		
Anser indicus (Latham)	9	*Echinostoma* sp.
		Strigea sp.
Tadorna ferruginea (Pallas)	7	*Apatemon casarcus* Vidyarthi, 1937.
Anas acuta Linnaeus	16	*Psilorchis seekhpari* n.sp.
		Tracheophilus sisowi acirratus n.var.
		Echinostoma crecci Verma, 1936.

Hosts	No. Examined	Trematodes
Anas clypeata Linnaeus	7	*Typhlophilus shovellus* Lal, 1936.
Nettapus coromandelianus (Gmelin)	8	Negative for trematodes.
Sarkidiornis melanotos (Pennant)	6	do.
ACCIPITRIDAE		
Milvus migrans (Boddaert)	19	*Haplorchis gyanpuri* n.sp. *Neodiplostomum* sp. *Echinochasmus* sp. *Opisthorchis* sp.
Accipiter trivirgatus (Temminck)	7	Negative for trematodes.
Torgos calvus (Scopoli)	16	*Opisthorchis* sp. *Strigea* sp. *Neodiplostomum* sp. *Holostephanus calyusi* Verma, 1936.
PHASIANIDAE		
Coturnix coturnix (Linnaeus)	12	Negative for trematodes.
Gallus gallus domesticus (Linnaeus)	11	*Neodiplostomum* sp.
RALLIDAE		
Amaurornis phoenicurus (Pennant)	7	Negative for trematodes.
JACANIDAE		
Metopidius indicus (Latham)	10	do.
CHARADRIIDAE		
Tringa glareola Linnaeus	9	do.
BURHINIDAE		
Burhinus oedicnemus (Linnaeus)	16	*Patagifer* sp. *Echinochasmus* sp. *Parastrigea* sp.
COLUMBIDAE		
Treron phoenicoptera (Latham)	9	Negative for trematodes.
Columba livia Gmelin	12	do.
CUCULIDAE		
Cuculus varius Vahl	9	*Ophiosoma macrocephala* Verma, 1936. *Neodiplostomum* sp.
ALCEDINIDAE		
Ceryle lugubris (Temminck)	10	*Pseudodiplostomum fraterni* Verma, 1936.
DICRURIDAE		
Dicrurus adsimilis macrocercus Vieillot	9	Negative for trematodes.
ARTAMIDAE		
Artamus fuscus Vieillot	4	*Stomylotrema* sp.
STURNIDAE		
Sturnus contra Linnaeus	8	*Cyathocotyle indica* Mehra, 1943.
CORVIDAE		
Corvus splendens Vieillot	18	*Stephanoprora fusca* Lal, 1939. *Echinostoma* sp.
MUSCICAPIDAE		
Brachypteryx stellata Gould	7	Negative for trematodes.

ACKNOWLEDGEMENTS

The author gratefully acknowledges the guidance of Dr. O. N. Srivastava, Professor and Head of the Zoology Department, K. N. Govt. College, Gyanpur, Varanasi, throughout this study. He is also grateful to Dr. K. N. Srivastava, Principal of the College, for providing financial assistance for this survey.

DEPARTMENT OF ZOOLOGY,
AGRA COLLEGE,
AGRA, U.P.,
July 4, 1966.

S. P. JAIN

9. RECOVERY OF RINGED BIRDS

Ring No. and species	Date and place of ringing	Date and place of recovery	Remarks
A–68609 *Acrocephalus stentoreus*	10-4-1965. Nalbani, Salt Lake, Calcutta (*c*.22° 34′N., 88° 22′E.)	3-9-1968. Uzbek SSR near Samarkand (39° 41′N., 66° 58′E.)	Reported by Bird Ringing Centre, Moscow, USSR
B–3671 *Tringa nebularia*	24-10-1966. Bharatpur, Rajasthan (27° 13′N., 77° 32′E.)	10-6-1968. Arkhangelsk Region, Leshukonskoe District, near Vozhgora (64° 35′N., 48° 25′E.)	-do-
C–1407 *Anas crecca* ♂	8-10-1966. -do-	3-9-1968. Altai Region, near Novoaltaisk (53° 26′N., 83° 53′E.)	-do-
C–1474 *Anas crecca*	11-10-1966. -do-	1-9-1968. Tomsk Region, near Bakchar (57° 08′N., 82° 01′E.)	-do-
C–1585 *Anas crecca* ♂	12-10-1966. -do-	15-9-1968. Nord Kazakhstan, near Mamlyutka (54° 85′N., 68° 32′E.)	-do-
C–2625 *Anas crecca* ♂	19-10-1966. -do-	8-9-1968. Alma-Ata Region, near Chilik (43° 37′N., 78° 15′E.)	-do-
C-2714 *Anas crecca* ♂	20-10-1966. -do-	14-5-1967. Krasnoyarsk Region, near Aginskoe (55° 16′N., 94° 56′E.)	-do-
C–2867 *Anas crecca*	23-10-1966. -do-	13-9-1968. Omsk Region, near Nazyvaevsk (55° 36′N., 71° 20′E.)	-do-
C–3215 *Anas querquedula* ♀	9-10-1967. -do-	31-8-1968. Novosibirsk Region, near Studenoe (Karasuk District) (55° 40′N., 77° 31′E.)	-do-
C–3408 *Anas querquedula* ♀	26-10-1967. -do-	5-9-1968. Karaganda Region, Lake Balkhash	-do-

RECOVERY OF RINGED BIRDS—(*contd.*)

Ring No. and species	Date and place of ringing	Date and place of recovery	Remarks
C–3660 *Anas crecca* ♂	5-11-1967. Bharatpur, Rajasthan (27° 13′N., 77° 32′E.)	31-8-1968. Kokchetav Region, near Volodarskoe (53° 20′N., 66° 13′E.)	Reported by Bird Ringing Centre, Moscow, USSR
C–3740 *Anas crecca* ♂	6-11-1967. -do-	8-9-1968, Omsk Region, near Nazyvaevsk, near Mangut (55° 49′N., 70° 46′E.)	-do-
C–3809 *Anas crecca* ♀	7-11-1967. -do-	25-9-1968. Karaganda Region, Lake Balkhash	-do-
C-4096 *Anas crecca* ♂	12-11-1967. -do-	15-9-1968. Kurgan Region, near Makushino (55° 12′N., 67° 13′E.)	-do-
C–4401 *Anas crecca* ♀	30-11-1967. -do-	15-9-1968. Altai Region, near Pospelikha (51° 59′N., 81° 49′E.)	-do-
C–4440 *Anas crecca* ♀	30-11-1967. -do-	15-9-1968. Novosibirsk Region, near Kupino (54° 22′N., 77° 18′E.)	-do-
C–4464 *Anas crecca* ♀	1-12-1967. -do-	3-9-1968. Taldy-Kurgan Region, near Ush-Tobe (49° 19′N., 78° 00′E.)	-do-
C–4571 *Anas crecca* ♀	5-12-1967. -do-	15-9-1968. Altai Region, Shipunovo District, near Zerkaly (52° 30′N., 81° 50′E.)	-do-
C–4578 *Anas querquedula* ♂	5-12-1967. -do-	9-5-1968. Tomsk Region, (56° 45′N., 84° 92′E.)	-do-
C–4808 *Anas crecca* ♀	9-12-1967. -do-	2-9-9-1968. Tomsk Region, near Melnikovo (56° 36′N., 84° 06′E.)	-do-
C–4874 *Anas crecca* ♂	21-12-1967. -do-	1-9-1968. Semipalatinsk Region, near Udzhar (47° 08′N., 81° 37′E.)	-do-
C–5146 *Anas crecca* ♂	4-2-1968. -do-	31-8-1968. Taldy-Kurgan Region, Lake Alakol (46° 20′N., 81° 25′E.)	-do-
C–5187 *Anas crecca* ♂	8-2-1968. -do-	31-8-1968. Dzhambul Region, near Ulanbel (44° 55′N., 71° 07′E.)	-do-
C–5272 *Anas crecca* ♀	1-3-1968. -do-	4-10-1968. Leninobad Region, near Begovat (40° 15′N., 69° 12′E.)	-do-
C–5423 *Anas crecca* ♀	23-2-1968. -do-	8-9-1968. Taldy-Kurgan Region, Lake Alakol (46° 20′N., 81° 25′E.)	-do-

RECOVERY OF RINGED BIRDS—(*contd.*)

Ring No. and species	Date and place of ringing	Date and place of recovery	Remarks
C–5432 *Anas crecca* ♀	26-2-1968. Bharatpur, Rajasthan (27° 13′N., 77° 32′E.)	15-9-1968. Altai Region, Shipunovo District, near Zerkaly (52° 30′N., 81° 50′E.)	Reported by Bird Ringing Centre, Moscow, USSR.
C–5509 *Anas crecca* ♀	3-3-1968. -do-	8-9-1968. Kazakhstan, Balkhash Lake, Ili River (45° 28′N., 74° 10′E.)	-do-
F–1437 *Anas acuta* ♀	20-10-1966. -do-	25-8-1968. Krasnoyarsk Region, near Kazachinskoe (57° 45′N., 93° 15′E.)	-do-
F–2393 *Anas clypeata* ♂	21-11-1967. -do-	5-8-1968. Taldy-Kurgan Region, near Kalpe (45° 10′N., 77° 56′E.)	-do-
F–2657 *Anas penelope* ♀ ?	29-11-1967. -do-	18-9-1968. Tomsk Region, near Kolpashovo (58° 21′N., 82° 56′E.)	-do-
F–3303 *Fulica atra* 0 (?)	21-12-1967. -do-	9-9-1968. Altai Region, near Solonovka (52° 16′N., 80° 51′E.)	-do-
F–3859 *Aythya ferina* ♂	5-1-1968. -do-	1-9-1968. Novosibirsk Region, near Barabinsk (55° 24′N., 78° 21′E.)	-do-
F–4011 *Aythya ferina* ♂	14-1-1968. -do-	1-9-1968. Novosibirsk Region, Lake Ubinskoe (55° 30′N., 80° 00′E.)	-do-
F–4295 *Fulica atra* 0 (?)	26-1-1968. -do-	Spring 1968. Taldy-Kurgan Region, near Aksu (45° 40′N., 79° 29′E.)	-do-
F–4553 *Aythya fuligula* ♂	5-2-1968. -do-	18-9-1968. Taldy-Kurgan Region, near Alakol (46° 20′N., 81° 21′E.)	-do-
F–4720 *Aythya ferina* ♀	11-2-1968. -do-	26-9-1968. -do-	-do-
F–5032 *Anas penelope* ♀	19-2-1968. -do-	25-8-1968. Tomsk Region, near Krivosheino (57° 24′N., 83° 56′E.)	-do-
F–5092 *Anas acuta* ♂	21-2-1968. -do-	1-9-1968. Altai Region, near Rubzovsk (51° 32′N., 81° 13′E.)	-do-
F–5470 *Anas acuta* ♂	27-2-1968. -do-	1-9-1968. Altai Region, near Tyumenzevo (53° 20′N., 81° 30′E.)	-do-
C–4447 *Anas crecca* ♀	1-12-1967. -do-	1-9-1968. Karaganda Region, near Karazhal (48° 01′N., 70° 51′E.)	-do-

RECOVERY OF RINGED BIRDS—(*contd.*)

Ring No. and species	Date and place of ringing	Date and place of recovery	Remarks
AB–15099 *Philomachus pugnax* ♀	24-10-1967. Bharatpur, Rajasthan (27° 13′N., 77° 32′E.)	0-3-1968. North of Kabul City	Reported by Syed Ali Akbari
C–2782 *Anas querquedula* ♀	21-10-1966. -do-	0-10-1968. Near Mettuppatti Village, Thiruchirapalli Dist., Madras (10° 16′N., 78° 8′E.)	Reported by A. R. James
C–4894 *Anas crecca* ♂	21-12-1967. -do-	29-9-1968. V. L. W. Sahar, Mathura Dist., U.P. (*c.* 27° 58′N., 77° 17′E.)	Reported by U. S. Rawut
F–4355 *Aythya fuligula* ♂	30-1-1968. -do-	7-11-1968. Chural Dist., Sangrur, Punjab State	Reported by Harbhajan Singh
F–1686 *Anas acuta* ♂	30-9-1967. -do-	5-10-1967. Village Parikonch, Salvarasa Dist., N. Bihar (25° 11′N., 85° 31′E.)	Reported by Ganesh Pd Singh Shikari
F–5115 *Aythya ferina* ♀	22-2-1968. -do-	17-11-1968. Lake in Akera Dist., Gurgaon, Haryana, Punjab. (*c.* 28° 33′N., 77° 34′E.)	Reported by Dr. Shyam Singh, B.A.M.S.
F–2255 *Anas crecca* ♂	14-11-1967. -do-	27-11-1968. Azamgarh Dist., U.P. (*c.* 26° 27′N., 83° 52′E.)	Reported by Fazil (Traffic Supdt.)
F–4772 *Anas strepera* ♂	12-2-1968. -do-	26-11-1968. Shergarh tank, Ajmer Dist., 26° 27′N., 74° 37′E.	Reported by Maharaj Chandravir Singh, Ajmer
B-4515 *Philomachus pugnax* ♂	24-10-1967. -do-	17-11-1968. Bareilly Dist., Parsakhera railway station. (*c.* 28° 1′N., 78° 58′E.)	Reported by Narendra Singh
F–5767 *Fulica atra* 0 ?	7-3-1968. -do-	19-11-1968. Nowrangpur, Rohtak Dist. (*c.*28° 21′N., 76° 13′E.)	Reported by Nandaram
C–4994 *Nettapus coromandelianus*	4-1-1968. -do-	24-11-1968. Payagpur, Bahraich, U.P. 'Baghel Tal' (*c.*27° 4′N., 81° 3′E.)	Reported by Haizannasanad, Pharmacist
C–5133 *Anas crecca* ♂	1-2-1968. -do-	1-12-1968. Deoria Dist., U.P. (*c.*26° 5′N., 83° 57′E.)	Reported by Khurshed Alam Lari
F–4242 *Fulica atra* 0 (?)	23-1-1968. -do-	24-11-1968. Rupgunj Dist., Dacca, E. Pak. (23° 43′N., 90° 24′E.)	Reported by K. A. Fattah
AB–15326 *Philomachus pugnax* ♀	1-11-1968. -do-	30-11-1968. Village Atanga, Chandpur, Dist. Bareilly, U.P. (29° 8′N., 78° 16′E.)	Reported by Irfan Hussain Khan

RECOVERY OF RINGED BIRDS—(*contd.*)

Ring No. and species	Date and place of ringing	Date and place of recovery	Remarks
F–4603 *Aythya ferina* ♀	28-1-1968. Bharatpur, Rajasthan 27° 13′ N., 77° 32′E.	20-12-1968. Amritsar Dist., Punjab on the bank of River Beas (*c*.31° 10′N., 74° 30′E.)	Reported by Iqbal Singh, Sandhu
F–3895 *Aythya nyroca* ♂	8-1-1968. -do-	12-12-1968. Tilauna Village, Basti Dist. (*c*.26° 25′N., 82° 13′E.)	Reported by S. N. Tiwari
C–3061 *Anas crecca* ♂	1-10-1967. -do-	+30-8-1968. Altaisk Region, near Gornyak (50° 58′N., 81° 27′E.)	Reported by Bird Ringing Centre, Moscow, U.S.S.R.
C–3800 *Anas querquedula* ♂	6-11-1967. -do-	+15-10-1968. Tyumen Region, near Surgut (61° 46′N., 73° 28′E.)	-do-
C–3845 *Anas crecca* ♀	7-11-1967. -do-	+25-10-1968. Chimkent Region, near Tyulkubas (42° 30′N., 70° 18′E.)	-do-
C–4009 *Anas crecca* ♂	10-11-1967. -do-	+31-8-1968. Pavlodar Reg., near Ekibastuz (51° 44′ N., 75° 23′ E.)	-do-
C–4432 *Anas crecca* ♂	30-11-1967. -do-	+9-5-1968. Tyumen Reg., near Vagai (57° 54′ N., 69° 01′ E.)	-do-
C–4462 *Anas crecca* ♀	1-12-1967. -do-	+0-9-1968. Novosibirsk Reg., near Kupino (54° 22′ N., 77° 16′ E.)	-do-
C–4959 *Anas crecca* ♀	29-12-1967. -do-	+12-10-1968. Novosibirsk Reg., Karsuk (53° 45′ N., 78° 02′ E.)	-do-
C–5510 *Anas crecca* ♀	3-3-1968. -do-	+28-9-1968. Uzbek S.S.R. Fergana Reg., near Yangikurgan (40° 35′ N., 71° 09′ E.)	-do-
F–1302 *Anas acuta* ♀ (?)	12-10-1966. -do-	+3-9-1968, Tselinograd Reg., near Tselinograd (51° 12′ N., 71° 25′ E.)	-do-
F-1455 *Anas acuta* ♀	20-10-1966. -do-	+22-3-1968. Karaganda Reg., near Kievka (50° 18′ N., 71° 33′ E.)	-do-
F-1698 *Anas acuta* ♂	1-10-1967. -do-	+11-9-1968. Tyumen Reg., near Nizhne Vartovskoe (60° 56′ N., 76° 36′ E.)	-do-
F-1740 *Anas acuta* ♂	13-10-1967. -do-	+26-9-1968. Omsk Reg., near Nizhnyaya, Omsk (55° 26′ N., 74° 54′ E.)	-do-

RECOVERY OF RINGED BIRDS—(*contd.*)

Ring No. and species	Date and place of ringing	Date and place of recovery	Remarks
F-1849 *Anas penelope* ♀?	25-10-1967. Bharatpur, Rajasthan (27° 13′ N., 77° 32′E.)	+25-8-1968. Irkutsk Reg., near Usolie (52° 45′ N., 103° 38′E.)	Reported by Bird Ringing Centre, Moscow, U.S.S.R.
F-1878 *Anas acuta* ♂	27-10-1967. -do-	+10-9-1968. Altai Reg., near Gornvak (50° 58′ N., 81° 27′ E.)	-do-
F-2242 *Anas acuta* ♂	11-11-1967. -do-	+1-10-1968. Taldy-Kurgan Reg., Alakul Dist., near Rybachie (46° 30′ N., 81° 46′ E.)	-do-
F-2270 *Fulica atra* 0 (?)	14-11-1967. -do-	+30-9-1968. Semipalatinsk Reg., near Zhana semei (50° 23′ N., 80° 14′ E.)	-do-
F-2341 *Fulica atra* 0 (?)	19-11-1967. -do-	+31-9-1968. Karaganda Reg., near Kievka (50° 18′ N., 71° 33′ E.)	-do-
F-2381 *Anas clypeata* ♂	21-11-1967. -do-	+22-9-1968. Uzbek S.S.R. near Fergana (40° 23′N., 71° 46′ E.)	-do-
F-2390 *Anas penelope* ♂	21-11-1967. -do-	+13-9-1968, Novosibirsk Reg., Kuibyshev Reg., near Bulatovo (55° 30′ N., 77° 49′ E.)	-do-
F-2414 *Anas clypeata* ♂	21-11-1967. -do-	+3-9-1968. Tyumen Reg., near Sladkovo (55° 30′ N., 70° 19′ E.)	-do-
F-2482 *Anas clypeata* ♂	23-11-1967. -do-	+17-9-1968. Novosibirsk Reg., near Kochenevo (55° 03′ N., 82° 11′ E.)	-do-
F-2553 *Anas clypeata* 0?	24-11-1967. -do-	+23-9-1968. Tomsk Reg., near Purabel (58° 41′ N., 81° 29′ E.)	-do-
F-2567 *Anas acuta* ♀	24-11-1967. -do-	+27-8-1968. Kemerov Reg., near Topki (55° 17′ N., 85° 38′ E.)	-do-
F-2707 *Fulica atra* 0 ?	30-11-1967. -do-	+25-9-1968. Semipalatinsk Reg., near Borodulikha (50° 45′ N., 80° 56′ E.)	-do-
F-2773 *Anas acuta* ♀	3-12-1967. -do-	+10-10-1968. Kurgan Reg., near Belozerskoe (55° 50′ N., 65° 34′ E.)	-do-
F-2884 *Aythya fuligula* 0?	5-12-1967. -do-	+15-5-1968. Tyumen Reg., near Vagai (57° 54′ N., 69° 01′E.)	-do-

RECOVERY OF RINGED BIRDS—(*contd.*)

Ring No. and species	Date and place of ringing	Date and place of recovery	Remarks
F-2922 *Aythya fuligula* 0 ?	8-12-1967. Bharatpur, Rajasthan (27° 13′ N., 77° 32′E.)	+3-9-1968. Khakassk Reg., near Abaoan (53° 42′ N., 91° 26′ E.)	Reported by Bird Ringing Centre Moscow, U.S.S.R.
F-2989 *Aythya fuligula* 0 ?	10-12-1967. -do-	+10-9-1968. Buryatian ASSR, the mouth of the Selenga (52° 20′ N., 106° 30′E.)	-do-
F-3302 *Fulica atra* 0 ?	21-12-1967. -do-	+21-9-1968. Kurgan Reg., near Polovinnoe (54° 47′ N., 65° 58′ E.)	-do-
F-3674 *Anas clypeata* ♂	29-12-1967. -do-	+20-10-1968. Alma-Ata Reg., near Alma-Ata (43° 12′ N., 76° 28′ E.,)	-do-
F-3861 *Aythya ferina* ♂	7-1-1968. -do-	+17-9-1968. Aktyubinsk Reg., near Chelkar (47° 50′ N., 59′ 36° E.)	-do-
F-3872 *Aythya nyroca* ♂	7-1-1968. -do-	+0-9-1968. Taldy-Kurgan Reg., near Sarkand (45° 13′ N., 79° 58′ E.)	-do-
F-3885 *Aythya ferina* ♂	8-1-1968. -do-	+31-8-1968. Kazakh S.S.R., Balkhash Lake (46° 6′ N., 75° 00′ E.)	-do-
F-3932 *Fulica atra* 0 ?	10-1-1968. -do-	+29-9-1968. Uzbek S.S.R. near Fergana (47° 23′ N., 71° 46′ E.)	-do-
F-4033 *Fulica atra* 0 ?	14-1-1968, -do-	+22-10-1968. -do-	-do-
F-4089 *Anas acuta* ♀	19-1-1968. -do-	+25-30-9-1968. Taldy-Kurgan Reg., Alakul Dist., Alakul Lake (46° 20′ N., 81° 09′ E.)	-do-
F-4099 *Anas acuta* ♂	19-1-1968. -do-	+13-7-1968. Tselinograd Region	-do-
F-4210 *Aythya ferina* ♂	23-1-1968. -do-	+14-9-1968. Tselinograd Reg., near Makinsk (52° 40′N., 70° 26′E.)	-do-
F-4321 *Aythya ferina* ♀	28-1-1968. -do-	+6-9-1968. Taldy-Kurgan Region, Alakul Dist., near Sasyk-tul Lake (46° 30′N., 81° 00′E.)	-do-
F-4430 *Aythya fuligula* ♀	31-1-1968. -do-	+24-5-1968. Yakutian A.S.S.R., near Vilyui (63° 44′N., 121° 35′E.)	-do-
F-4449 *Fulica atra* 0 ?	1-2-1968. -do-	+20-10-1968. Alma-Ata Reg., Balkhash Dist., the mouth of the Ili (45° 20′N., 74° 15′E.)	-do-

RECOVERY OF RINGED BIRDS—(*contd.*)

Ring No. and species	Date and place of ringing	Date and place of recovery	Remarks
F-4671 *Aythya ferina* ♂	8-2-1968. Bharatpur, Rajasthan (27° 13′ N., 77° 32′E.)	+0-5-1968. Tyumen Reg., near Armizonskoe (55° 56′N., 67° 39′E.)	Reported by Bird Ringing Centre, Moscow, U.S.S.R.
F-4739 *Aythya ferina* ♀	11-2-1968. -do-	+8-9-1968. Tyumen Reg., near Berdyuzhie (55° 48′N., 68° 19′E.)	-do-
F-4765 *Aythya ferina* ♀	12-2-1968. -do-	+7-9-1968. Semipalatinsk Reg., near Kokpekty (48° 45′N., 82° 25′E.)	-do-
F-4906 *Aythya ferina* ♀	14-2-1968. -do-	+29-9-1968. Samarkand Region, near Nurata (40° 34′N., 65° 41′E.)	-do-
F-4915 *Fulica atra* 0 ?	14-2-1968. -do-	+25-10-1968. Taldy-Kurgan Region, Alakul Dist., near Rybachie (46° 30′N., 81° 46′E.)	-do-
F-5178 *Fulica atra* 0 ?	23-2-1968. -do-	+28-30-9-1968. Taldy-Kurgan Reg., Alakul Dist., Alakul Lake (46° 20′N., 81° 09′E.)	-do-
F-5229 *Anas acuta* ♂	26-2-1968. -do-	+14-9-1968. Chimkent Reg., near Suzak (44° 10′N., 68° 27′E.)	-do-
F-5633 *Anas acuta* ♂	1-3-1968, -do-	+29-9-1968. Novosibirsk Reg., near Bagan (54° 07′N., 77° 39′E.)	-do-
A-76805 *Passer hispaniolensis* ♂	17-12-1967. -do-	+5-7-1968. Dzhambul Reg., near Cholepak (42° 38′N., 70° 31′E.)	-do-
F-4363 *Anas clypeata* ♂	30-1-1968. -do-	+14-5-1968. Tomsk Reg., near the town of Kolpashovo (58° 21′N., 82° 56′E.)	-do-
F-3738 *Aythya nyroca* ♀	1-1-1968. -do-	22-12-1968. Gorakhpur Dist., U.P. (*c.* 27° 30′N., 84° 26′E.)	Reported by K. M. Panday
AB-15190 *Tringa glareola* 0?	30-10-1967. -do-	22-12-1968. Lake in Periakottai village, 8m. south of Sivaganga (9° 51′N., 78° 30′E.)	Reported by Prof. O. N. Gurumani (Sivaganga)
66-342 *Sarkidiornis melanotos* ♀	26-2-1968. -do-	30-12-1968. In River Ganges, Karhagola Dist., Bihar (25° 11′N., 85° 31′E.)	Reported by Mr. Shausher Singh
B-4715 *Philomachus pugnax* ♂	1-11-1967. -do-	30-10-1968. Vill. Dahia, Monghyr Dist., Bihar	Reported by Shri Amar Nath Roy
F-3862 *Aythya ferina* ♂	7-1-1968. -do-	13-1-1969. Akera Teh. Gurgaon Dist., Haryana	Reported by Mr. A. Sattar Khan

RECOVERY OF RINGED BIRDS—(*contd.*)

Ring No. and species	Date and place of ringing	Date and place of recovery	Remarks
C–3544 *Anas querquedula* ♂	29-10-1967. Bharatpur, Rajasthan (27° 13′ N., 77° 32′E.)	11-1-1969. Near Sampla Dist. Rohtak, Haryana	Reported by Shri Hanwant Bir Singh, Delhi
F–4975 *Anas acuta* ♂	18-2-1968. -do-	29-12-1968. Sahoke's pond. 20 miles west of Sangroor, Punjab	Reported by Sewa Singhvirk, Sangroor Dist.
AB–13602 *Philomachus pugnax* ♀	8-10-1967. -do-	25-1-1969. Samdham Lake, Sahaswan Tah. Baudaun Dist., U.P. (28° 2′N., 79° 7′E.)	Reported by Shri Ramakrishna Saxena
C–4852 *Nettapus coromandelianus* ♀	15-12-1967. -do-	During 1968. Monghyr Dist., Bihar (25°23′N., 86° 28′E.)	Reported by B.N.H.S. Bird trappers
F–2276 *Fulica atra* 0 ?	14-11-1967. -do-	During 1968. -do-	-do-
F–3713 *Fulica atra* 0 ?	31-12-1967. -do-	-do-	-do-
F–3771 *Netta rufina* ♂	3-1-1968. -do-	-do-	-do-
F–3886 *Aythya ferina* ♀	8-1-1968. -do-	-do-	-do-
F–4291 *Aythya ferina* ♀	26-1-1968. -do-	-do-	-do-
66–176 *Sarkidiornis melanotos* 0 ?	26-11-1967. -do-	-do-	-do-
AB–14550 *Philomachus pugnax* ♀	23-10-1967. -do-	2-2-1969. Sitapur, U.P. (29° 14′N., 70° 51′E.)	Reported by Kabir Ahmad Khan
F–2774 *Anas acuta* ♀	3-12-1967. -do-	17-2-1969. Lake Singhar. 40 miles from Lucknow, Dist. Sitapur (27° 54′N., 80°18′E.)	Reported by Shaukat Ali
F–5491 *Anas acuta* ♂	28-2-1968. -do-	20-2-1969. Dhori Vill. Gujarat, via Sarai Alamgir	Reported by M. Ahmad Hussain
C–4492 *Anas crecca* ♂	1-12-1967. -do-	Jan. 1969. Goverdhan, Mathura Dist., U.P.	Reported by Mukhtan Singh
C–2731 *Anas crecca* ♂	20-10-1966. -do-	28-2-1969. Pilibhit, U.P. (28° 6′N., 79° 37′E.)	Reported by S.P. Bajpai, U.P.
C–5578 *Anas crecca* ♀	4-3-1968. -do-	21-2-1969. Sheikhupura Dist., W. Pakistan	Reported by Ch. Mohmad Anne Cheema
C–4324 *Anas crecca* ♀	26-11-1967. -do-	19-1-1969. Ran Basera, Jhalawar Dist., 50 miles from Kota	Reported by Major Manohar Singh

Note. + = shot or killed by man.

BOMBAY NATURAL HISTORY SOCIETY,
HORNBILL HOUSE,
BOMBAY 1-BR.
March 31, 1969.

EDITORS

10. OCCURRENCE OF THE PIT-VIPER *TRIMERESURUS MALABARICUS* (JERDON) ON THE GHODBUNDER ROAD (THANA DIST.) WITH SOME NOTES ON THEIR HABITS

From October 24 to December 23, 1968, I found eight specimens of the pit-viper *Trimeresurus malabaricus* on the Ghodbunder road. The sizes ranged from 240 mm. to 840 mm.; five specimens were found dead on the road, two were found live crossing the road and one live one was found on a bush in a roadside ditch. All living specimens were found at night as well as most of the dead ones, pointing to the nocturnal habits of this species. The live specimens were all kept and are living in a terrarium at the time of this writing. The two smaller snakes (260 mm., 280 mm.) feed on small frogs, although they show an interest in the mice that the larger one (840 mm.) is fed. When feeding they strike and hold their prey till dead and then swallow; a frog died in nine minutes after being grabbed by one of the small vipers; a mouse died in two minutes from the bite of the large one, a second mouse died after six minutes. When not gorged with food the snakes become very active in the evening, searching the glass for a way out; during the day they remain coiled (often together) on a branch in the cage. When approached or molested I have noticed the large one vibrating its tail, as observed with many other snakes including *Ptyas mucosus*, *Boiga*, as well as American and Japanese pit-vipers genus *Ancistrodon*, and of course the rattlesnakes, *Crotalus*. The coloration of *T. malabaricus* is slightly variable, one of the live young ones being a much lighter green than the others. The dark zig-zag markings are more prominent in the larger specimens, being much more distinct when the snake is distended with food and more noticeable in the darkness of the cage than in the light while photographing them. No other species of pit-vipers were found by me in the area in question.

C/o K. Chattopadhyaya,
6, Chateau Marine,
Marine Drive,
Bombay,
January, 1969.

ROMULUS WHITAKER

11. ABNORMAL COLORATION IN THE BANDED KRAIT, *BUNGARUS FASCIATUS* (SCHNEIDER)

(With a plate)

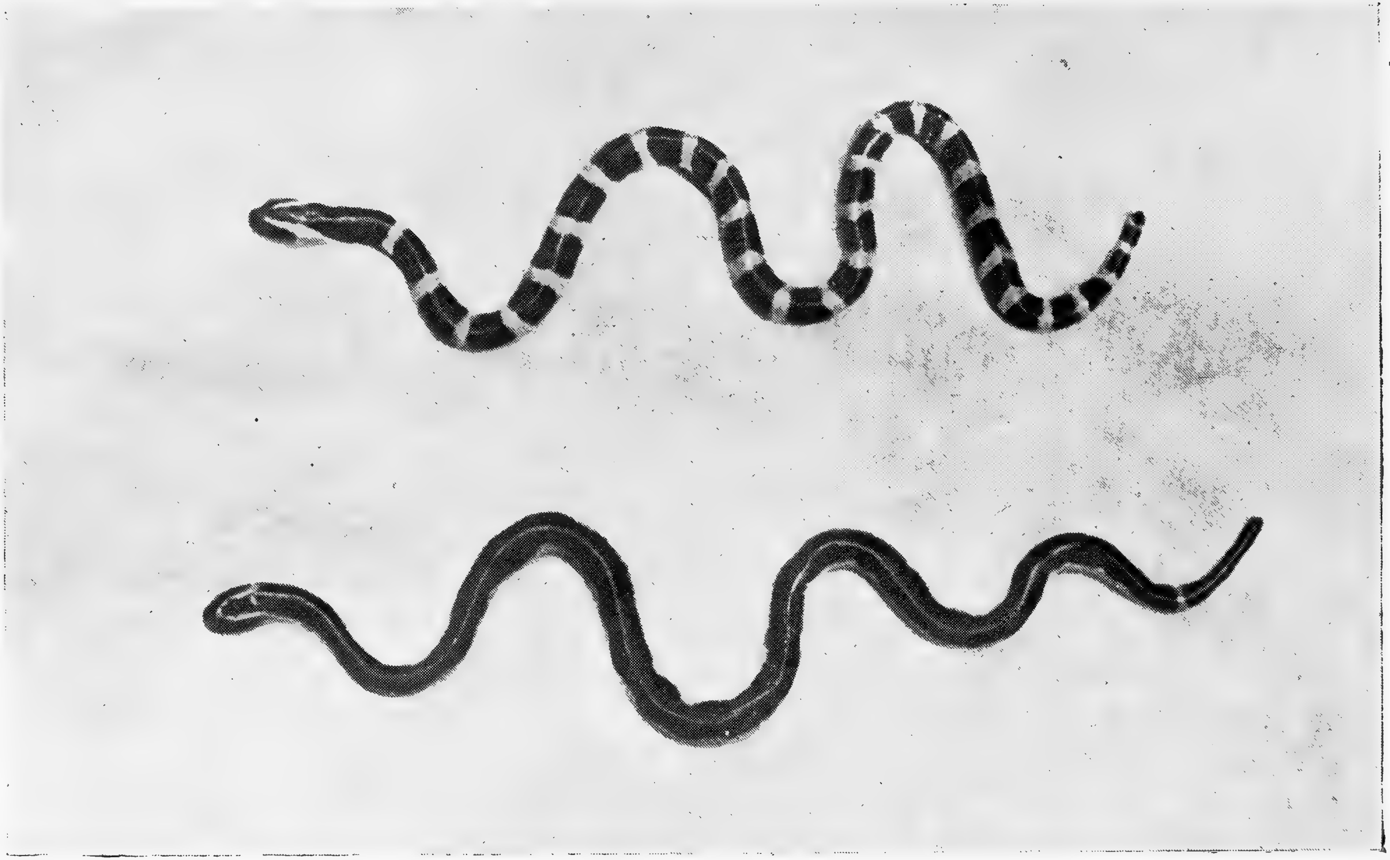
A specimen of Banded Krait (*Bungarus fasciatus*), purchased from Calcutta (location of capture given as 'near Calcutta'), female 1250 mm. long, was abnormally coloured in that, except for two near the tail, the typical transverse bars were absent. Instead, the black pigment was arranged in an irregular wavy line the whole length of the body and tail, covering most of the dorsum. At a few points the black coloration appears to begin cross bands but nowhere meets the ventrals except as mentioned earlier. Head pattern and scalation same as average *B. fasciatus*. Scalation: Dorsal 15 rows; ventrals 226; caudals 26. The specimen was gravid and en route to Bombay deposited twelve eggs in the bag on April 3. Six of these eggs spoiled some days later, the remaining six were incubated and hatched on June 5. All six young were marked as described above, none with more than two complete bands. Average length 255 mm. Scalation did not differ from normal. No mention of this aberration is made by Wall or Malcolm Smith; it corresponds to the not uncommon variation of other banded snakes (as *Lampropeltis*) which are normally banded, but which sometimes have a line, lines, or band running the length of its body. The venom-extraction officer of Haffkine Institute, Mr. N. E. Vad, says that though he had never seen one, he has heard of specimens from Assam and Burma of this pattern-type.

All snakes were kept for over a month, after which four were released, one is preserved, with a normal juvenile *B. fasciatus* at the Bombay Natural History Society's collection. The photograph illustrates both normal and aberrant forms of *Bungarus fasciatus* (juveniles).

C/o K. Chattopadhyaya,
6, Chateau Marine,
Marine Drive,
Bombay,
December 1, 1968.

ROMULUS WHITAKER

Whitaker: Banded Krait.



Above: Normal coloration of *Bungarus fasciatus* (juvenile);
Below: Aberrant form of *Bungarus fasciatus* (juvenile).

12. SOME NOTES ON THE HABITS OF THE INDIAN RAT SNAKE (*PTYAS MUCOSUS* LINN.) IN A LOCALITY NEAR BOMBAY

Collecting reptiles in an area on the Ghodbunder Road (Thana Dist.) during the last year, I have found the Dhaman or Rat Snake to be the most common large terrestrial snake. Local people often misleadingly call dhamans 'Nag' or 'Nagin', when actually cobras are far less common (or at least not in evidence). In the last year I have seen about 35 dhamans (28 caught) and seen 5 cobras (4 caught). Five of the twenty-eight dhamans were juveniles three feet or under in length, but most of those seen and caught averaged 6-7 feet, the maximum being eight feet four inches (this large specimen was in the act of stalking a hare which was sitting motionless watching the snake, seemingly transfixed with interest and/or fear, but definitely not hypnotized as it was quick to recognize us as intruders and make off, the snake being detained by means of leap and a grab). Almost half the dhamans were taken from village houses and huts at the request of the human residents. The houses often have rat nests and rats in residence which are of course the attraction to the snakes. They are sometimes found coiled in a rats' nest digesting the previous occupants.

All dhamans are excitable and may bite (though somewhat clumsily) at first, but most will become tame if handled regularly. Six of those caught emitted a fairly loud 'growl' from deep in the throat when first grabbed (recorded by Col. Wall). When approached in a corner, or cage they may swell up their throats and arch the neck and body and make long lunges with partly open mouth. When encountered in thick bush they often get away, having the advantage in thorny and rocky places. They may be captured by either jumping on them before they get away (although their superficial resemblance to cobras makes this a dubious practice) or a helper could try to head the snake off and drive it toward you (if one keeps still, a snake may crawl right up to, over, and past you with no cognizance of what you are). I have dug them out of rat tunnels, from under the roots of trees, from rock piles, rubbish piles and from out of hollow trees.

In the one area concerned the colour variation has been from a deep olive (almost black) to very light brown in adults, the young always being a medium greenish-brown. Most specimens, especially young ones, feed well in captivity on frogs, rats and birds; even rats 24 hours dead are taken. Most adult dhamans have scars (and sometimes fresh cuts) inflicted by rats which they kill by pressure from their body and mouth rather than constriction in the sense of tightening coils; frogs are swallowed alive.

On July 13 one 6½ feet dhaman laid 14 eggs; one spoiled and thirteen hatched on Sept. 16, 17; average length of young was 385 mm.

Most places in and around Bombay that have some extensive gardens or heavy growth provide food and shelter for the Indian rat snake; they are to be found on Cumballa and Malabar Hills and parts of Colaba in Bombay proper. From Worli and Dadar onwards they become increasingly common as unused property is more extensive.

There is little doubt that this rodent-destroying snake should be protected, especially now that there is a demand for their skins. It is a species that survives well in the vicinity of man (provided man does not destroy it), is innocuous and is probably a more efficient rat-catcher than any other creature.

C/o K. Chattopadhyaya,
6, Chateau Marine,
Marine Drive,
Bombay,
January, 1969.

ROMULUS WHITAKER

13. FOOD AND FEEDING HABITS OF THE INDIAN SAND SKINK, *OPHIOMORUS TRIDACTYLUS* (BLYTH) BOULENGER

Ophiomorus tridactylus usually feeds in the evening, shifting its time of emergence according to the prevailing temperature. During summer it feeds late in the evening but in winter in the early hours just after sun-set. During rains and on windy days it does not emerge at all. Once at Barmer (1 Sept., 1967), I was able to collect 35 specimens between 8 and 10 p.m., but the next night at the same time with a strong, cool wind blowing, only 3 were caught.

Usually these skinks keep only their heads above the sand and stay motionless. Any moving prey coming near their mouth is snapped at. Ordinarily the prey is crushed by the jaws and battered on the ground before being swallowed. Observations on the mode of feeding were also made in semi-captive and captive conditions.

Semi-captivity: A dozen skinks of both sexes, were kept in an enclosure measuring 120×90 cm. which had a boundary wall to prevent their escape. This enclosure was built away from human

TABLE 1

PERCENTAGE VOLUME OF THE FOOD ITEMS FOUND IN THE STOMACH OF *Ophiomorus tridactylus* IN VARIOUS MONTHS OF THE YEAR, 1967

Food items (Insect orders) ..	Jan. (6)	Feb. (15)	March (15)	April (16)	May (16)	June (14)	July (14)	Aug. (15)	Sept. (18)	Oct. (17)	Nov. (8)	Dec. (6)
Isoptera ..	70	60	50	40	50	65	60	70	75	70	60	75
Lepidoptera ..	—	—	—	15	10	7	—	—	2	3	3	—
Orthoptera ..	—	—	10	15	8	3	5	2	4	2	5	—
Dictyoptera ..	—	—	—	—	7	5	—	—	4	—	4	—
Coleoptera ..	30	40	40	30	25	20	35	28	15	25	28	25

Note : Figures in parenthesis denote the number of stomachs examined.

habitation, so that the skinks were not unnecessarily disturbed. The enclosure was filled with loose sand made into the form of a small sand-dune and the skinks remained comfortably buried in the loose sand. Wooden pegs were also stuck in the sand, which were soon attacked by termites which provided ample food to the skinks.

Captivity: A dozen skinks were also kept in the laboratory in a glass terrarium, with a removable screen top, and with a deep layer of dry sand at the bottom for the skink to burrow in.

Different varieties of food were given to the skinks separately and together. Food was given in the morning at about 9 a.m. once every twenty-four hours. Each experiment was repeated four times and with fresh sets of skinks.

The skinks were never observed drinking though water was provided in semi-captivity and captivity. Food habits were studied by examining the stomach contents of freshly captured skinks and were analysed volumetrically. The volume of insects of one order has been expressed as the volume of the total stomach contents and the data have been pooled month-wise for a year (Table 1), from which, it is evident that the order Isoptera (termites) forms by far the majority of the lizards' food throughout the year. Coleoptera

TABLE 2

FOOD IN NATURE : ANALYSIS OF STOMACH CONTENTS

Month	No. of Stomachs	Food Items
January	6	a. Legs and heads with mouth parts of termites. b. Elytra and heads of beetles.
February	15	a. Legs and heads with mouth parts of termites. b. Elytra and heads with mouth parts of beetles. c. Entire termites.
March	15	a. Appendages, pieces of wings and heads of grasshoppers. b. Appendages and mouth parts with heads of termites. c. Entire small beetles. d. Elytra, body parts and heads of beetles.
April	16	a. Head of grasshopper. b. Appendages and heads of termites. c. Elytra and heads of beetles. d. Mouth parts of Lepidoptera.
May	16	a. Head of small cockroach. b. Appendages and heads of termites. c. Elytra and legs and heads of beetles. d. Head of *Gryllus*. e. Antennae of moth.

TABLE 2—(*contd.*)

Month	No. of Stomachs	Food Items
June	14	a. Entire beetle. b. Appendages and heads of termites. c. Wings, legs and head of a moth. d. Mouth parts of *Gryllus*. e. Legs of a grasshopper. f. Head and legs of cockroach.
July	14	a. Appendages and head with mouth parts of termites. b. Elytra and heads of beetles. c. Mouth parts of grasshopper. d. Wings and head pieces of some insects.
August	15	a. Elytra, heads and entire small beetles. b. Appendages and heads of termites. c. Entire termites without legs. d. Wings and head of grasshopper.
September	18	a. Elytra and heads of beetles. b. Appendages and heads of termites. c. Legs, wings, and heads of moths. d. Small cockroach crushed. e. Head and mouth parts of *Gryllus*. f. Crushed small grasshopper. g. Pieces of wings of some insects.
October	17	a. Appendages and heads of beetles. b. Appendages and heads of termites. c. Heads of grasshopper. d. Legs of insects. e. Heads of cockroach.
November	8	a. Appendages and mouth parts of beetles. b. Appendages and mouth parts of termites. c. Heads of moths. d. Appendages and heads of grasshopper. e. Heads of cockroach.
December	6	a. Appendages and mouth parts with heads of termites. b. Appendages and mouth parts with heads of beetles. c. Entire termites.

The skinks were collected every month throughout the year 1967 and their stomach contents were examined.
Details of food items, which could be identified from food contents are summarised in the table above.

(Beetles) comes next, the percentage volume of beetles vary from 15 to 40 per cent throughout the year. Lepidoptera and Orthoptera appear from March-April to November. Their inclusion in the skink food may be due to the lower availability of Isopteran and Coleopteran insects. The study of the stomach contents of *Ophiomorus tridactylus* shows that it is purely an insectivorous lizard.

Feeding trials on a wide variety of freshly killed insects and other edible materials, both animal and plant, were done with captive skinks and it was observed that Isopteran insects were preferred. No plant material was taken.

MAHARISHI DAYANAND COLLEGE,
SRIGANGANAGAR, RAJASTHAN, M. S. RATHOR
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14. FISH FAUNA OF UDAIPUR LAKES

INTRODUCTION

The State of Rajasthan has great potentialities for the growth of Inland Fisheries. There are a large number of rivers, lakes, tanks and seasonal ponds. However, very little is known of the fish fauna of Rajasthan. Earlier publications of Mathur (1952), Krishna & Menon (1958) and Datta Gupta *et al* (1961) are not comprehensive. Hence, faunal studies of the fish population of the State were undertaken. The present paper forms a part of this study and deals with the fish fauna of Udaipur city popularly known as city of lakes.

MATERIALS AND METHODS

Weekly collections of fish were made throughout the year in 1965-66 from short stretches of water at various selected centres in Pichhola, Swaroop Sagar and Fateh Sagar Lakes. Every catch was sorted and fish obtained were preserved in 5% formalin. Morphometric observations along with the weights of different fishes were taken. Sex and stage of maturity were also recorded. Gill nets, cast nets, and sometimes drag nets were used for collections.

PHYSICAL FEATURES

Udaipur city (25°N. 75°E.), situated at 1983 ft. above sea-level, is surrounded by minor hills of the Aravalli ranges. To its south-east runs the Shisharma River which is formed by an assemblage of various streamlets from the adjoining hills. This silt-laden seasonal river flows into Lake Pichhola, which was constructed in the year 1382. It is connected with Amarkund, and Rang Sagar and extends into Swaroop Sagar Lake completed in the year 1916. The latter passes out its surplus water through a waste weir to the River Ahar or to Fateh Sagar Lake.

Fateh Sagar Lake receives its water from three sources, from the adjoining hills, from Swaroop Sagar and from the Madar Channel. The total catchment area of Fateh Sagar Lake is about 8 sq. miles, and its dam is 2600 ft. in length. On one side of the dam is a waste weir through which surplus water is passed out. The submerged area of this lake is approximately 639 acres. During rains surplus water of Fateh Sagar and Swaroop Sagar meet to drop into the River Ahar, which flows down and is dammed at Udai Sagar Lake about 8 miles from Udaipur.

The soil of these lakes is loamy and the average depth of water in these lakes is about 18 ft. during rains, the maximum being towards the dam up to 40 ft. during rains, and about 10 ft. during summer. The temperature of these lakes varies from 15°C. in December-January to 34°C. in May-June. Turbidity is highest during monsoon and lessens from September reaching its minimum in February and March. The plankton fauna at the margin is poor probably due to heavy growth of weeds. It is, however, rich in other regions of the lakes and is mainly composed of rotifers, copepods, *Cladocera*, shrimps, *Mysis*, *Oscillatoria*, *Anabaena*, *Microcystis* etc. Floating weeds are uncommon but submerged weeds like *Hydrilla verticillata*, *Vallisnaria sprit*, *Potamogeton crispus* and *Chara brachypus* are present.

Fish Fauna

A list of fishes with their local and scientific names have been presented in the Table. Besides these, information about the maximum size, habitat, seasonal availability and breeding habits of economically important species have been mentioned. The general classification of fishes adopted in the table is that of Berg (1940).

Discussion

Out of thirty-five species of fishes collected during the present survey of the three lakes of Udaipur city, majority belong to the family Cyprinidae. The families Siluridae, Cobitidae and Channidae fall next in sequence, rest of the families are represented by one species each.

TABLE

S. No.	Species	Local Name	Maximum Size Observed	Remarks
	CYPRINIDAE			
1.	*Labeo rohita* (Ham.)	Rohu	3 ft.	Frequently available. An excellent table fish, breeds during south-west Monsoon (July-August).
2.	*Labeo calbasu* (Ham.)	Kalaunt	3 ft.	Common major carp of the waters of Udaipur.
3.	*Labeo gonius* (Ham.)	Sarsi	2 ft. 4 in.	Most abundant in Swaroop Sagar and Pichhola Lakes as compared to Fateh Sagar.
4.	*Labeo boggut* (Sykes)	Dudhya	8 in.	Frequently available.
5.	*Labeo bata* (Ham.)	Bata	1 ft.	Occasionally netted.
6.	*Cirrhina mrigala* (Ham.)	Mrigal or Narain	3 ft.	Available throughout the year in fairly good numbers and is much esteemed as food.
7.	*Cirrhina reba* (Ham.)	Reba	1 ft.	Occasionally netted.
8.	*Tor khudree* (Sykes)	Mahseer	2 ft. 5 in.	Available in large numbers in Fateh Sagar than in Swaroop Sagar and Pichhola Lakes, important both as food fish and game fish, specimens from 2 lb. to 10 lb. are considered to taste better compared to fishes of larger weights which are coarse and oily.
9.	*Puntius sophore* (Ham.)	Puthi	3 in.	Available throughout the year.
10.	*Puntius sarana* (Ham.)	Puthi	11 in.	Available throughout the year.
11.	*Puntius ticto* (Ham.)	Puthi	3 in.	Available throughout the year.
12.	*Chagunius chagunio* (Ham.)	Puthi	4 in.	Uncommon.
13.	*Chela clupeoides* (Bloch)	Silver chal	6 in.	Available throughout the year in large numbers and forms a good table fish.
14.	*Chela bacaila* (Ham.)	Chal	7 in.	Available in large numbers, larvicidal in habits.
15.	*Danio devario* (Ham.)	Chaudlore	4 in.	Very rarely netted, larvicidal in habits.
16.	*Garra gotyla* (Gray)	Pathar chata	6 in.	Very rarely netted.
17.	*Amblypharyngodon mola* (Ham.)	Melwa	4 in.	Found in large numbers.
18.	*Barilius bendelisis* (Ham.)	Galva	6 in.	Available throughout the year.
19.	*Barilius barna* (Ham.)	Gala	3 in.	Not very common.
20.	*Rasbora daniconius* (Ham.)	Zebra	6 in.	Commonly available throughout the year.
	COBITIDAE			
21.	*Noemachielus botia* (Ham.)	Bamna	2 in.	Very rarely netted.
22.	*Botia lohachata* Chaudhri	Bamna	6 in.	Rarely netted.
23.	*Lepidocephalichtys guntea* (Ham.)	—	3 in.	Very rarely netted.

S. No.	Species	Local Name	Maximum Size Observed	Remarks
	SILURIDAE			
24.	*Wallago attu* (Bloch & Schneider)	Lanchi	5 ft.	Very common in these waters, bottom feeder, regarded as a very undesirable fish in tanks and ponds as it destroys smaller fishes.
25.	*Mystus seenghala* (Sykes)	Singhara	4 ft.	Next only to *Wallago attu* in its economic importance. Predatory fish, breeds in April and May, available throughout the year and is a good table fish.
26.	*Mystus cavasius* (Sykes)	Katava	9 in.	Available throughout the year.
27.	*Mystus bleekeri* (Ham.)	Katarna	5 in.	Rarely netted.
28.	*Ompok bimaculatus* (Bloch)	Pabda	11 in.	Frequently available during south-west monsoon.
	SACCOBRANCHIDAE			
29.	*Heteropneustes fossilis* (Bloch)	Singhi	1 ft.	Available throughout the year, dreaded for its venomous pectoral spines.
	OPHIOCEPHALIDAE (Channidae)			
30.	*Channa marulius* (Ham.)	Saval	4 ft.	Occasionally netted from these waters.
31.	*Channa punctatus* (Bloch)	Girhi	8 in.	Frequently available.
	CENTROPOMIDAE (Ambassidae)			
32.	*Ambassis nana* (Ham.)	Sisa	3 in.	Available throughout the year.
	NOTOPTERIDAE			
33.	*Notopterus notopterus* (Pallas)	Chitala	1 ft. 6 in.	Found in large numbers throughout the year.
	BELONIDAE			
34.	*Xenentodon cancila* (Ham.)	Suyia	1 ft.	Commonly available.
	MASTACEMBELIDAE			
35.	*Mastacembelus armatus* (Lacépéde)	Bam.	2 ft.	Available throughout the year, people generally do not prefer it because of its snake-like appearance.

Cyprinid fishes collected from these lakes consist of twenty species. The genus *Labeo* alone is represented by five species. It is interesting to note that in Swaroop Sagar and Pichhola, the population of *Labeo gonius* is more in comparison to that found in Fateh Sagar where *Labeo rohita* forms the most important fishery; *Tor khudree* and *Cirrhina mrigala* are also present in appreciable quantity in the latter. *Catla* has so far not been observed from any of these lakes. However, it has been frequently collected from Udai Sagar and Jaisamand Lakes which are at a distance of eight and thirty-three miles respectively from Udaipur city.

Family Siluridae is represented by five species of which two are economically important.

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Department of Animal Husbandry (Fisheries),
Jaipur, Rajasthan, (Miss) S. DHAWAN
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15. OBSERVATIONS ON LARGE SCALE DESTRUCTION OF CARP EGGS IN BREEDING *HAPAS* BY THE COMMON CARP, *CYPRINUS CARPIO* (LINNAEUS)

Considerable progress has been made in India in the application of the technique of induced breeding of Indian carps for commercial production of quality seed (Chaudhuri & Alikunhi 1957; Chaudhuri 1966; Ibrahim & Chaudhuri 1966; Ranganathan *et al* 1967; Bhowmick & Chaudhuri *in press*). One of the serious problems encountered during regular induced breeding experiments at Cuttack has been the mysterious disappearance of large quantities of eggs from breeding *hapas*. Though pituitary injected breeders used to spawn completely, only very few eggs could be recovered finally from the *hapas*, resulting in considerable loss of spawn year after year. While conducting induced breeding experiments at Cuttack, Alikunhi *et al* (1964) noticed the disappearance of eggs from breeding *hapas*. It is also reported (Anon, 1967) that synthetic enzymes and foul water containing a lot of micro-organisms cause quick disintegration of eggs. However, no satisfactory explanation has been advanced so far for the large scale disappearance of eggs from *hapas*.

During the 1967 fish breeding season the presence of a number of specimens of *Cyprinus carpio* (common carp) inside a slightly torn breeding *hapa*, in which a set of rohu had spawned, gave room for suspicion that this species could be the cause for the large scale destruction of eggs. Since eggs developed normally when kept in hatching *hapas*, in the same pond or in trays with the same pond water, the question of pond water having anything to do with the destruction of eggs was ruled out. A series of experiments were, therefore, conducted to confirm whether common carp was actually responsible for the destruction of eggs.

A breeding *hapa* was fixed in a pond having Indian and Chinese carps (grass carp and silver carp), common carp and other fishes, and measured quantity of eggs were released in it, but the eggs were not recovered. A small portion of the same pond was subsequently partitioned with fry net cloth after ensuring that there were no fishes in the partitioned area and breeding *hapas* were fixed on both sides of the partition. Measured quantities of eggs were then introdced in both the *hapas*. Survival of eggs in the protected *hapa* was quite satisfactory in contrast to very poor survival in the unprotected one.

Complete survival of eggs was recorded when eggs were introduced in breeding *hapas* fixed in ponds where there was no fish population, or the fishes consisted of only the Indian major carps catla, rohu and mrigal or the Chinese grass carp and silver carp or weed fishes like *Oxygaster*, *Puntius* and *Amblypharyngodon*. Thus, observations conducted in a number of ponds suggested that none of these fishes destroyed eggs.

Direct observations carried out in a small channel confirmed the inference that common carp was causing the destruction of eggs. The channel was partitioned into two with a small-meshed wire net and eleven common carp were released on one side of the partition, the other side serving as control. Measured quantities of eggs were then released in breeding *hapas* fixed on either side of the partition actually within a distance of a few centimetres. In the stocked section common carp were observed to hover around the *hapa* and nibble and suck at it repeatedly with their protrusible mouth. At the end of the experiment eggs were completely recovered from the control *hapa* in contrast to very poor survival in the *hapa* fixed in the stocked half of the channel.

All the experiments when repeated five to six times gave similar results and pooled data are presented in the table.

DETAILS OF VARIOUS EXPERIMENTS CARRIED OUT SHOWING PREDATION OF EGGS BY COMMON CARP

Sl. No.	Experimental Environment	No. of eggs released in *hapa*	No. of eggs recovered after five to six hours
1.	Pond having no fish in it	552,000	552,000
2.	(*a*) Pond having Indian and Chinese carp, common carp and other smaller fishes	759,000	6,000
	(*b*) Partitioned portion of the same pond but without any fish	380,000	380,000
3.	Pond having Indian and Chinese carps and common carp	362,000	20,000
4.	Pond having only Indian major carps	345,000	345,000
5.	Pond having only Chinese carps	207,000	207,000
6.	(*a*) In channel with wire net partition having only common carp	586,000	40,000
	(*b*) In the same channel, outside wire net partition having no common carp	586,000	586,000

Common carp can penetrate silty bottom to a depth of over 12 cm. (Nikolsky 1963) and up to 6 cm. in hard clay substrata in search of food (Alikunhi 1966). The situation of the mouth prevents the fish from catching its food straight from water, and it picks its food by sucking from the bottom (Sarig 1966). Alikunhi (*loc. cit.*) states that common carp being an opportunistic polyphagous feeder takes its food according to local availability. They are reported to feed on young and eggs of game fishes (Malpas 1920) and prey on the spawn of other species including the Sacramento perch (Wales 1942). The tactile and taste organs of this benthophagic carp are used for searching prey (Nikolsky, *loc. cit.*). Helped by these organs the fish are probably attracted towards the breeding *hapas* having large quantities of eggs. They move around the *hapa* and suck at its sides and bottom. Being demersal in nature, the eggs settle down in the *hapa* and as the fish suck from outside, the egg shells apparently break. It is evident that the presence of small openings on the breeding *hapa* cloth, intended for free movement of water, adds to the efficiency of the sucking power of common carp. This has been demonstrated by keeping eggs in *hapa* of finer meshed cloth where the extent of damage to the eggs was less than in the breeding *hapa.*

Thus, eggs in breeding *hapas* fixed in a pond having common carp are subject to heavy destruction by this fish. Indian and Chinese carps as well as weed fishes do not cause such damage to the eggs. It is therefore necessary that ponds having no common carp in them should be selected for induced breeding work.

Further, predation of carp eggs by common carp recorded here and the destruction of young and eggs of game fishes and perch referred to earlier in this note could be investigated for control and culture of fishes like *Tilapia* where there is problem of over-population.

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CENTRAL INLAND FISHERIES RESEARCH SUB-STATION,
CUTTACK,
September 1, 1967.

G. C. PANICKER
K. H. IBRAHIM
R. M. BHOWMICK

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16. INDUCED BREEDING OF MAJOR CARPS IN GUJARAT STATE WITH A NOTE ON SPAWNING OF CARPS IN BOKH RESERVOIR, PRANTIJ

The area of water available in Gujarat State for pisciculture amounts to about 5000 hectares, but only 2000 hectares are being utilised for fish culture and the State requires about 7·6 million fry for stocking them as against the present production of only 1·6 million, the bulk of which is obtained from rivers (Anon. 1966). The State used to import large quantities of fry from West Bengal involving expenditure, for instance of Rs. 2550 for 0·26 million fish seed from Calcutta in 1961 (Anon. 1966).

Since the success of induced breeding of carps in India (Chaudhuri & Alikunhi 1957) and development of this technique (Chaudhuri 1960; Alikunhi *et al* 1960; Chaudhuri 1954) the technique has been successfully applied for production of quality fish seed on a commercial scale in several States and in Gujarat since 1962, the production of fish seed has gone up in succeeding years by the application of this method (Anon. 1966). An account of the induced breeding experiment in 1962 in the State for the first time and a note on the natural spawning of carps in Bokh reservoir, Prantij, are presented here.

An extensive survey conducted in 1962 showed that carps bred in Bokh reservoir, Prantij, connected with the Hatmati River. During monsoon, this reservoir receives rain water from an extensive catchment area and also from the Hatmati River. The ecological conditions are generally comparable to those of the wet type of bundhs described by Alikunhi *et al* (1964) around Nowgong, Madhya Pradesh.

Spawning of minor carps and other small fishes was observed throughout day and night on 13 July 1962 with inundation of the shallow margins by heavy rain. Active spawning of Rohu and Mrigal commenced on the night of 13 July, 1962, when water was let in from the river. Chasing of females by males and mating was seen in very shallow waters. Sometimes fishes were observed even rubbing against persons standing at such places and ejecting eggs in the process. Fishermen could catch fishes easily during spawning with cast nets. It is interesting to note that the fish were not scared by the movement caused by people wading through water though Alikunhi *et al* (1964) observed that 'sudden movement of water scared the fishes away, which return to spawning ground within a few minutes'.

Spawning behaviour of the fish in this reservoir is more or less similar to those described by Dubey & Tuli (1961) and Alikunhi *et al* (1964). Difficulties encountered in collection of fish seed from the natural spawning ground were simultaneous breeding of minor carps and other fish, poor arrangements for hatching of eggs, predation of eggs and hatchlings by insects. Further, the eggs collected from the breeding ground were in various stages of development involving difficulties in hatching them together.

There is an abundant stock of major carps, mainly Rohu in the reservoir. Attempts to breed them by pituitary injections were initiated from 6th July and experiments were carried on till 12th August. 14 sets of Rohu and 4 sets of Mrigals were injected during this period. Details of experiments are presented in the table.

TABLE

DETAILS OF EXPERIMENTS ON INDUCED BREEDING

Particulars	*Labeo rohita*	*Cirrhina mrigala*
1. No. of sets injected	14	4
2. Weight of breeders (range)	♀ 2·00-4·5 kg. ♂ 2·00-4·00 kg.	2·5-3·5. kg. 2·0-4·0 kg.
3. No. spawned	5	1
4. Dose (range) I	2·0-2·5 mg./kg. body wt.	2·5 mg./kg.
4. Dose (range) II	6 mg./kg.	not given.
5. Dose (range) when spawning obtained	2·5 kg.-6 mg.	2·5 mg.
6. Fertilisation (range)	82·00-94·00%	63%
7. Water temperature (range)	28·8°-32·2°C	28·8°-32·0°C
8. Spawn obtained	1,90,000	Nil

In all experiments breeders were collected either by gill net or by cast nets. Collection and stocking of breeders well in advance of breeding season was not possible due to lack of suitable stocking ponds and hence the fishes were collected only 12 hours prior to injection. They were either kept in hand nets or in condition *hapas* till the time of injection.

Glands were collected from fully ripe Rohu, Mrigal and Catla. In most cases freshly collected glands were used for injection and in a few cases glands preserved in absolute alcohol for 3 days without refrigeration were used.

Breeding *hapas* were fixed in reservoir where there was a slight flow of water. High atmospheric temperature, normally 40°C prevailed during such periods and hence injection was given only on comparatively cooler days when water temperature was between 28·8°-32·2°C, mainly during rainy days.

Spawning occurred 4-10 hours after injection. Percentage fertilisation was between 63-94 except in one case where fertilisation was poor. Eggs hatched out 14-18 hours after fertilisation.

Out of 18 sets injected, only 6 gave successful results. In some cases where the *hapas* were fixed in areas covered with lotus, the eggs were found to be decomposed and it was noticed that vegetation near these *hapas* was decomposing which probably was a contributory cause. From these experiments 1,90,000 hatchlings were obtained.

In many of the successful cases, fish responded to one injection at a lower dose of even 2·5 mg./kg. body weight of the recipients. In pond-reared fishes, an initial low dose of 2-3 mg./kg. body weight and after about 6 hours an effective dose of 5-8 mg./kg. body weight for females are reported to give successful results (Chaudhuri 1966). However, from the present observation, it appears that fishes collected from natural spawning ground require comparatively lower dose as they are in prime condition. Even stripping and artificial fertilisation of fishes collected from natural breeding grounds can be attempted for the production of fish seed, wherever possible so that the use of pituitary material can be avoided.

Fish seed requirements of Gujarat State had been calculated to be 100 million, 50 million and 15 million in terms of spawn, fry and fingerlings respectively, while the present production of fish seed is too inadequate when the State proposes to bring an additional water area of 4000 hectares under fish culture during the fourth plan. The bulk of the production is restricted to river collection which is reported to contain 80% economic species (Anon. 1964). Obvious limitations of river collection such as dependence on several ecological and meteorological factors as also the uncertainty of the quality of fish seed collected, necessitates intensification of induced breeding methods in the State.

The present experiments on breeding of major carps were the first undertaken in Gujarat State. Inadequate facilities like lack of ponds and trained personnel were responsible for the limited success. However, the success achieved indicated that there was ample scope for developing Bokh reservoir as a major fish seed production centre in the State.

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CENTRAL INLAND FISHERIES RESEARCH SUB-STATION, CUTTACK,
G. C. PANICKER
October 9, 1968.

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17. THE GIANT AFRICAN LAND SNAIL *ACHATINA FULICA* BOWDICH IN BIHAR

The Giant African Land Snail *Achatina fulica*, a native of East Africa, is now widely distributed in all trophical and subtropical countries. In India it has been reported from Bengal (Hornell 1951), Orissa (Behura 1955), Kerala and Andaman-Nicobar Islands.

The snail, is a serious pest of garden crops, vegetables, rubber, tea and coffee plantations in all countries of its introduction (Jutting 1934; Rees 1950). The first record of its introduction in Bihar was made by Ray (1943), from Santhal Parganas. Since then almost nothing was known of its distribution and behaviour in the State. Our investigations show that *A. fulica* is now well distributed and established in several districts of Bihar namely, Darbhanga, Muzaffarpur, Motihari, Purnea, Saharsa and Santhal Parganas.

Observations made in Purnea show that the snails are very active in the early morning during November to March, and can withstand cold up to 8·8°C. Feeding during this period is restricted to winter vegetables like cabbage, cauliflower, groundnut pods, etc., to which serious damage is inflicted and sometimes two-to-three transplantings of vegetable seedlings have to be made. In the absence of these preferred food, the snail feeds on grasses like *Cyanodon dactylon*. They are most active during the rainy season and feed on kitchen refuse, garbage and all types of vegetables, ornamentals, graminaceous wild plants and some weeds but no damage has so far been observed on paddy crop. *A. fulica* even climbs trees such as banana, *litchi*, citrus, mango, papaya, etc. and damages their foliage. As reported by Behura (1955), the snail is active not only at night but also during mornings and evenings. Considerable numbers are crushed under vehicles while crossing roads in the evening hours.

During hot and sunny weather they hide under dense vegetation. They are active during the day time in cloudy weather only. In case of intermittent sun and clouds, they are sometimes found moving about. They breed during August-September, the former being the most active month. The snails overwinter and aestivate till the end of May and appear again with pre-monsoon rains. Overwintering and aestivation takes place in wet places in the soil at a depth from 72-144 mm. during which the operculum appears to be sealed by protective calcareous matter.

Control by dusting common salt crystals over crawling snails has proved to be effective.

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PLANT PROTECTION OFFICE,
BIHAR,
PATNA,
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CHARAN SINGH
R. B. S. BIRAT

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18. PRELIMINARY OBSERVATIONS ON THE RELATIVE RESISTANCE OF SELECTED SPECIES OF INDIAN TIMBER TO GRIBBLE (*LIMNORIA*) ATTACK

(*With a plate*)

INTRODUCTION

Occurrence of the crustacean wood borer *Limnoria*, commonly known as Gribble, along the Indian coast was first reported by Palekar & Bal (1957), who collected a few specimens from timber panels immersed in Bombay harbour They also noted that crustacean borers are not of any economic importance in the vicinity of Bombay harbour in view of their stray occurrence. The specimens collected by them were assigned to a new species, *Limnoria* (*Limnoria*) *bombayensis* (Pillai 1961). Becker (1959) collected two species, *L. indica* Kampf. & Becker and *L. tripunctata* Menzies from Madras and Mandapam. Five other species have been recorded from the Andaman Islands also (Bernard 1936; Ganapati & Rao 1960). Apart from these records no information is available either on their biology or on the damage caused by them to various species of Indian timber.

Several investigators have pointed out that no timber is resistant to *Limnoria* attack. Even green-heart (*Ocotea rodiaei*), considered highly resistant to marine wood borers, is not immune to the attack of *Limnoria* (Stevenson 1874; Edmondson 1955: 29). Moreover no poison is known that is really effective against them and it is found that creosote treatment merely retards and does not prevent *Limnoria* attack. It is reported that *Limnoria* attacks even timber which is impregnated with corrosive sublimate (Mullins & Mullins 1848).

During October-November 1964, a sudden outbreak of damage by *Limnoria* (*Limnoria*) *bombayensis* was noticed on the experimental timber panels immersed in the Bombay harbour and since then they were found to have done considerable damage to the panels of some of the timber species (see plate). Details on the incidence of *Limnoria* on various species of Indian timber tested are given in the present paper.

Materials and Methods

In the present study 25 timber species, belonging to 14 families, were tested in two series in Bombay harbour under the Mazagaon Pier. The experimental site is well under tidal influence and during extreme low tide the panels are exposed to the atmosphere for two to three hours. Moreover, the sea bottom in the area is clayish and muddy and the water is, therefore, usually turbid due to the action of the propellers of boats that ply in this area. The water is also polluted with oil from their engines. Despite these drawbacks, this site was selected as *Limnoria* is found to occur in large numbers only in this locality. Attempts to collect them from other places along Bombay coast were not successful.

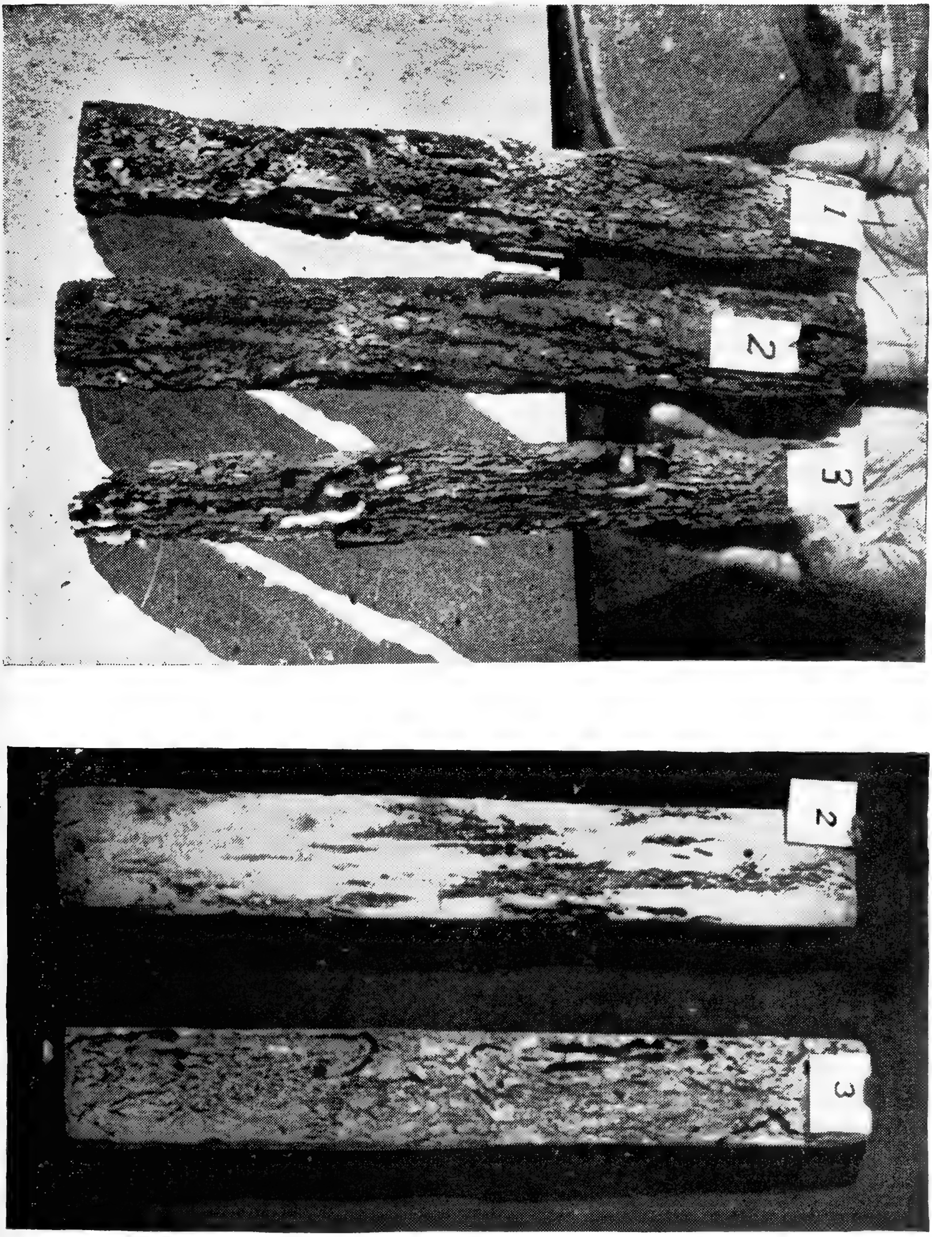
Untreated timber panels (0) of 30·5 cm.×3·8 cm.×3·8 cm. size were immersed together with panels treated with creosote and Ascu, both in two absorptions, 10 lb. (C_1) and 20 lb. (C_2) per cu. ft. in the case of the former and 1 lb. (A_1) and 2 lb. (A_2) per cu. ft. in the case of the latter, so as to find out their efficacy to prevent borer attack. For each treatment, panels in triplicate were kept (Panels A, B & C). The timber panels were procured from various States and in some cases panels of the same species, obtained from different States, were also tested. The panels were periodically examined and the number of *Limnoria* tunnels were counted and recorded.

Results

Tables 1 and 2 show the incidence of *Limnoria* on the various species of timber tested. The following list gives the affected species of timber arranged in the order of increasing preference on the basis of the degree of attack on untreated controls at the final inspection.

A. Durability Test Series I (Period of immersion—14 months).

(1) *Bombax ceiba*
(2) *Cryptomeria japonica*
(3) *Cedrus deodara*
(4) *Dysoxylum malabaricum*
(5) *Picea smithiana*
(6) *Pinus wallichiana*
(7) *Abies pindrow*



Above: Panels showing heavy attack of *Limnoria bombayensis* after immersion for 18 months. 1 & 2. *Pinus longifolia*; 3. *Alstonia kurzii*; *Below:* 2. *Pinus longifolia* after immersion for 6½ months; 3. *Bombax insigne* after immersion for 18 months.

B. Durability Test Series II (Period of immersion—18 months).

(1) *Shorea robusta* (West Bengal).
(2) *Shorea robusta* (Bihar).
(3) *Terminalia paniculata.*
(4) *Tetrameles nudiflora.*
(5) *Tectona grandis* (Madras).
(6) *Albizzia* spp.
(7) *Polyalthia fragrans.*
(8) *Salmalia insignis.*
(9) *Alstonia kurzii.*
(10) *Pinus roxburghii.*

The results also show that *Artocarpus hirsuta, Broguira* spp. *Terminalia alata* var. *nepalensis, Anogeissus latifolia, Shorea robusta* (Assam), *Terminalia arjuna, Mangifera indica* and *Tectona grandis* (Bombay) belonging to the Series I, and *Dipterocarpus indicus, Xylia xylocarpa, Pterocarpus dalbergioides, Shorea robusta* (Uttar Pradesh) and *Tectona grandis* (Andhra) belonging to the Series II, have considerable resistance to *Limnoria*, even after a period of 14 to 18 months.

In test I, only panels of group C were available for inspection at the end of 14 months. In this there was no attack on the treated panels, except the Ascu treated (1 lb./cu. ft.) panel of *Bombax ceiba* and creosote treated (10 lb./cu. ft.) panel of *Picea smithiana.*

From Table 2, it can be seen that the two preservatives, Ascu and Creosote, gave complete protection against *Limnoria* upto a period of 10 months (except in the case of *Alstonia kurzii* treated with Ascu at 1 lb./cu. ft.), after which they were no longer capable of preventing the attack of *Limnoria.* It is also found that Creosote treated panels were significantly less attacked than the Ascu treated ones. This may be due to the comparatively higher degree of leachability of Ascu, which is more water soluble than Creosote.

In the untreated condition the coniferous varieties tested are easily attacked by *Limnoria.* Becker (1959), also collected his specimens from Madras coast from panels of *Pinus roxburghii, Bombax ceiba* and *Cryptomeria japonica.* It is interesting to note that *Dysoxylum malabaricum*, a species included in the class I grade after grave yard tests at Forest Research Institute and Colleges, Dehra Dun, (average life 180 months and above) has very little resistance to marine borers and suffers heavy attack by *Limnoria* within 8 months of immersion. *Cedrus deodara* and *Tectona grandis*, included in class II grade after land tests (average life 120 to 179 months), though not heavily attacked, are susceptible to marine borers within 2 and 6½ months, respectively, of immersion. As can be seen from Table 2, only *Tectona grandis* procured from Madras indicated mild attack by *Limnoria* and those obtained from Andhra and Bombay remained unattacked.

Conclusions and Summary

1. Results on the relative susceptibility of 25 species of timber, commonly used in marine constructions to the attack of *Limnoria bombavensis* in Bombay waters indicate that most of them do not have any natural resistance and hence should be used only after proper preservative treatment.

2. According to Edmondson (1955: 72), the natural durability of timber is not a family or generic character, but clearly specific. This is supported by the present observation on *Salmalia insignis* and *Bombax ceiba. Salmalia insignis* shows *Limnoria* incidence within $6\frac{1}{2}$ months of immersion and is heavily attacked within 18 months, while *Bombax ceiba* did not show any sign of incidence after 8 months and was only mildly attacked after 14 months.

3. Silica content of teak varies considerably in different samples, being practically absent in some (Edmondson 1955: 67). The durability of woods is often correlated with a high silica content (Gonggrijp 1932; Bianchi 1934) and inconsistencies in the performance of samples from the same species of timber is usually explained as due to variations in the silica content. However, recent studies on the extractives of teak wood (Sandermann & Simatupang 1966) revealed that a compound namely Tectochinon is the agent responsible for the natural resistance of teak. Nevertheless, the slight difference noticed in the response of teak samples procured from Madras, Andhra and Bombay is difficult to explain, as the resistant factors in them are not yet studied in any detail.

4. The coniferous timber, in general, lacked resistance to *Limnoria.* This is in close agreement with the results obtained by Edmondson (1955: 53), who after testing various species of *Pinus* from the United States, found that all were heavily attacked by *Teredo* and *Limnoria* after submergence for two or three years. In the present study, the attack was much more severe and the whole surface of some of the panels was riddled by *Limnoria* to a depth of 1 cm. within a period of six to eight months. It is to be noted in this connection that marine borer activity is far more severe in the tropical waters than in the temperate regions.

5. Heart-wood of *Cryptomeria japonica* was heavily attacked by *Limnoria* within 14 months. In Hawaiian waters only slight attack was noted after ten months (Edmondson 1955: 63).

TABLE 1

THE INCIDENCE OF *Limnoria* (*Limnoria*) *bombayensis* (PILLAI) ON UNTREATED PANELS OF DURABILITY TEST SERIES I AFTER 14 MONTHS IMMERSION

Timber species	Locality	Panels	No. of *Limnoria* tunnels after immersion for			
			2 months	6 months	8 months	14 months
Conniferae						
		A	..	100	N	
Abies pindrow	Punjab	B	9	38	N	
(Fir)		C	3	38	N	N
Picea smithiana	Kashmir	A	..	51	127	
(Spruce)		B	38	97	N	
		C	..	14	152	N
Cedrus deodara	Kashmir	A	..	..	..	
(Deodar)		B	1	3	38	
		C	4	48	153	N
Pinus wallichiana	Uttar Pradesh	A	9	65	157	
(Kail)		B	27	36	N	
		C	4	37	124	N
Taxodiaceae						
Cryptomeria		A	..	..	1	
japonica		B	..	..	29	
(Suji)		C	2	2	24	N
Meliaceae						
Dysoxylum mala-	Coorg	A	..	3	N	
baricum		B	..	..	missing	
(White Cedar)		C	..	..	missing	
Bombacaceae						
Bombax ceiba	Kutch	A	..	..	..	
(Semul)		B	..	..	..	
		C	..	..	..	50
Rhizophoraceae						
		A				
Broguira spp.	Andamans	B				
		C				
Combretaceae						
Terminalia alata	Andhra	A				
var. *nepalensis*		B				
(Laurel)		C				
Terminalia arjuna	Bihar	A				
(Arjun)		B				
		C				
Anogeissus latifolia	Andhra	A				
(Axle-wood)		B				
		C				
Moraceae						
Artocarpus hir-	Coorg	A		No attack		
suta		B				
(Anjali)		C				
Dipterocarpaceae						
Shorea robusta	Assam	A				
(Sal)		B				
		C				
Anacardiaceae						
Mangifera indica	Orissa	A				
(Mango)		B				
		C				
Verbenaceae						
Tectona grandis	Bombay	A				
(Teak)		B				
		C				

N=Numerous

TABLE 2

THE INCIDENCE OF *Limnoria* (*Limnoria*) *bombayensis* (PILLAI) ON PANELS OF DURABILITY TEST SERIES II AFTER 18 MONTHS IMMERSION

Timber Species	Locality	Panels	No. of *Limnoria* tunnels after immersion for						
			6½ months	10 months	18 months				
			0	0	0	A_1	A_2	C_1	C_2
Apocynaceae									
Alstonia kurzii	Andamans	A	41	127	N	N	42	..	..
		B	..	N	N	42	47	..	..
		C	N	N	N	52	..	..	..
Leguminosae									
		A	14	21	N	..	22	..	..
Albizzia spp.	Andamans	B	..	..	143	30	51	..	..
		C	..	..	27	39	..	..	..
Anonaceae									
		A	6	9	N	4	..	..	..
Polyalthia fragrans (Gauri)	Coorg	B	..	4	35	31	4	29	..
		C	67	73	missing	65	..	..	..
Conferae									
Pinus roxburghii (Chir)	Jammu & Kashmir	A	27	157	N	14	..	..	..
		B	N	N	N	133	7	52	12
		C	N	N	N	77	..	..	..
Bombacaceae									
Salmalia insignis	Andamans	A	..	..	N	..	..	..	..
		B	..	..	N	..	7	17	..
		C	8	12	139	..	..	..	..
Verbenaceae									
Tectona grandis (Teak)	Madras	A	..	..	2	..	..	..	..
		B	..	..	11	..	..	..	..
		C	2	2	3	..	..	..	..
Dasticaceae									
Tetrameles nudiflora (Maina)	Andamans	A	..	4	5	..	..	..	..
		B	..	..	7	..	..	..	..
		C	..	..	..	..	..	..	..
Dipterocarpaceae									
Shorea robusta (Sal)	W. Bengal	A	..	..	..	..	..	..	..
		B	..	..	1	..	..	..	..
		C	..	..	..	..	..	..	..
Shorea robusta (Sal)	Bihar	A	..	..	..	..	..	..	..
		B	..	..	5	..	..	..	..
		C	..	..	..	..	..	..	..
Combretaceae									
Terminalia paniculata (Kindal)	Bombay	A	..	..	..	..	..	..	..
		B	..	..	25	..	..	..	..
		C	..	..	..	..	..	..	..

TABLE 2—(*contd.*)

THE INCIDENCE *Limnoria* (*Limnoria*) *bombayensis* (PILLAI) ON PANELS OF DURABILITY TEST SERIES II AFTER 18 MONTHS IMMERSION

Timber Species	Locality	Panels	No. of *Limnoria* tunnels after immersion for						
			6½ months	10 months	18 months				
			0	0	0	A_1	A_2	C_1	C_2
Verbenaceae									
Tectona grandis (Teak)	Andhra	A B C							
Dipterocarpaceae									
Dipterocarpus indicus (Gurjan)	Coorg	A B C							
Shorea robusta (Sal)	Uttar Pradesh	A B C	No attack						
Leguminosae									
Xylia xylocarpa (Irul)	Bombay	A B C							
Pterocarpus dalbergioides (Andaman Padauk)	Andamans	A B C							

0=Untreated control; A_1=Ascu 1 lb. per cu. ft.; A_2=Ascu 2 lb. per cu. ft.; C_1=Creosote 10 lb. per cu. ft.; C_2=Creosote 20 lb. per cu. ft.; N=Numerous.

No attack was noticed on the treated panels upto 10 months; except on a panel of *Alstonia kurzii* treated with Ascu (1 lb. per cu. ft.) which indicated one tunnel after 6½ months and 3 tunnels after 10 months.

6. Creosote treatment appears more effective than Ascu treatment. Though initially there was no difference in their effectiveness, continued immersion in sea water resulted in the leaching out of Ascu quicker than Creosote and after 18 months the Ascu treated panels lacked resistance to *Limnoria* attack.

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CENTRAL INSTITUTE
OF FISHERIES EDUCATION,
KAKORI CAMP, POST BOX 7392,
BOMBAY-58,
June 27, 1968.

L. N. SANTHAKUMARAN

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19. THE STATUS OF *RHIPICEPHALUS SANGUINEUS* (LATREILLE 1806) AND *R. TURANICUS* POMERANTZEV, 1940 (ACARINA: IXODIDAE) IN INDIA

(With two text-figures)

Hitherto four species of the genus *Rhipicephalus* Koch, 1844, namely, *R. sanguineus*, *R. haemaphysaloides*, *R. scalpturatus* and *R. ramchandrai*, have been definitely recorded in India (Dhanda 1966). Deoras & Gokhale (1958) reported the occurrence of *R. tricuspis* on rats in the city of Bombay, but its exact identity needs confirmation. In addition, *R. breviceps* was also described from the Indian subcontinent in Sind, now in Pakistan, on the basis of a single female (Warburton 1910). In practically all work done in India since Sharif (1928) published his monograph on Indian ticks, followed by the check-list by Sen (1938), Indian workers have been identifying the species of *Rhipicephalus* on the basis of keys provided by Sharif.

Recently, during a visit to the Virus Research Centre, Poona, Dr. Harry Hoogstraal of the U.S. Naval Medical Research Unit No. 3, Cairo, brought to our attention that while examining tick collections from India, from localities around Calcutta, he had come across only *R. turanicus*, and no *R. sanguineus*. *R. turanicus* was described by B. Pomerantzev in the year 1940, and it was hitherto known to be distributed in parts of U.S.S.R. and the Middle East. We have also just seen a paper by Mitchell & Spillett (1968) on the ecological notes on *R. turanicus* Pomerantzev in West Bengal, India, recording the occurrence of the species in West Bengal. Dr. Hoogstraal suggested that *R. sanguineus* collections at the Virus Research Centre be re-examined with a view to determine if any *R. turanicus* were present in other parts of the country also.

The distinguishing characters used to differentiate the two species are: (i) the presence of a small conical spur-like projection on the internal margin of the adanal shields in the male *R. turanicus*; such a projection is lacking in *R. sanguineus*. (ii) Shape of spiracular plate, which in *R. turanicus* shows a definite depression in the posterior third of its dorsal margin, and its posterior tip is bent dorsally. These characters are illustrated in figures 1 A and B, which are redrawn from illustrations provided by Pomerantzev (1950). In the female, the shape of spiracular plate has been referred to as the chief distinguishing character. It is not always possible to delineate this difference due to individual variations. Shatas (1956) has pointed out some differences in the immature stages of these two species also.

The specimens of '*R. sanguineus*' in the V.R.C. collections have been re-examined, based on the abovementioned characters of the adult

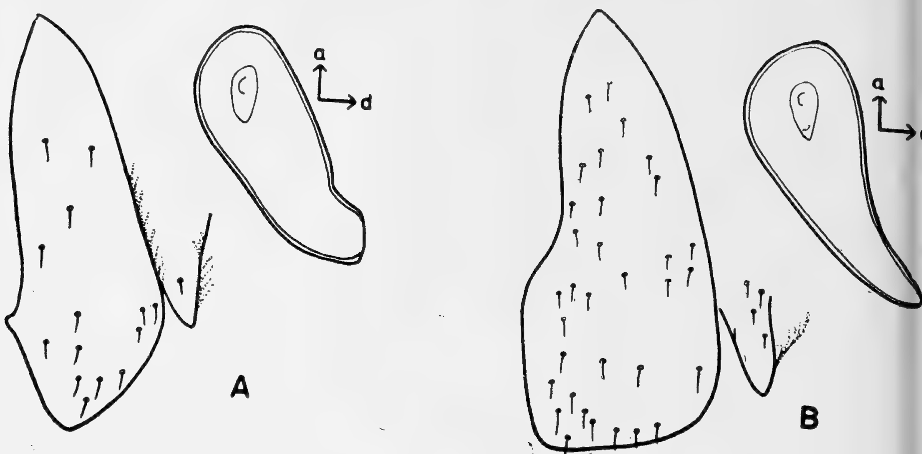

FIG. 1. Adanal shields and spiracular plates. A, *R. turanicus* ; B, *R. sanguineus*. (a=anterior ; d=dorsal). (Redrawn from Pomerantzev, 1950).

males. Both the characters showed a considerable degree of variations, but some specimens could definitely be identified as *R. sanguineus* (Figs. 2 H and I), while others as *R. turanicus*. In the latter, although a small conical projection on the internal margin of adanal shields could be easily detected, the spiracular plate did not exactly resemble that of *R. turanicus*, as illustrated by Pomerantzev; in most cases, however, its posterior tip was bent dorsally (Figs. 2, A to G).

On this basis, the V.R.C. collections contain *R. turanicus* like specimens from Kashmir, Madhya Pradesh, Gujarat, Maharashtra, Andhra Pradesh and Madras States; all the *R. sanguineus* like specimens so far examined are from localities around Poona (Maharashtra) only, as listed below:

R. turanicus. Jammu and Kashmir: 49 ♂♂, 33 ♀♀, A 21726 ; 8 ♂♂, 5 ♀♀, A 21737 ; 30 ♂♂, 4 ♀♀, A 21767 ; 24 ♂♂, 12 ♀♀, A 21882 ; 1 ♂, A 23862 ; 3 ♂♂, 1 ♀, A 23864 ; 6 ♂♂, 2 ♀♀, A 23865 ; 1 ♂, A 23869 ; 7 ♂♂, 2 ♀♀, A 23910 ; 22 ♂♂, 4 ♀♀, A 23913 ; 7 ♂♂, 5 ♀♀, A 23914 ; 6 ♂♂, 3 ♀♀, A 23953 ; 4 ♂♂, 2 ♀♀, A 23954 ; 4 ♂♂, 2 ♀♀, A 23955 ; 1 ♂, A 23956 ; 9 ♂♂, 4 ♀♀, A 23963 ; 4 ♂♂, 10 ♀♀, A 23965 ; all collected as ectoparasites off sheep and 2 ♂♂, A 23912, collected as ectoparasites off goats. The specimens were collected in the Vale of Kashmir, between 30 April and 19 May, 1959. Madhya Pradesh: 5 ♂♂, 1 ♀, A 61308, off dog, near Ratlam, on 4th March 1963. Gujarat : 1 ♂, A 49048, sheep, 19 March 1961 ; 1 ♂, A 49096, donkey, 2 April 1961 ; 1 ♂, 1 ♀, A 49055, buffalo, 28 March 1961 ; all collected in Kutch district ; 2 ♂♂, 1 ♀, Lab.

No. 223 (F 1 progeny of parent ♀ collected on 10 Sept. 1960, off dog at Jalander Bet, Saurashtra, A 39750). Maharashtra: 25 ♂♂, 1 ♀,

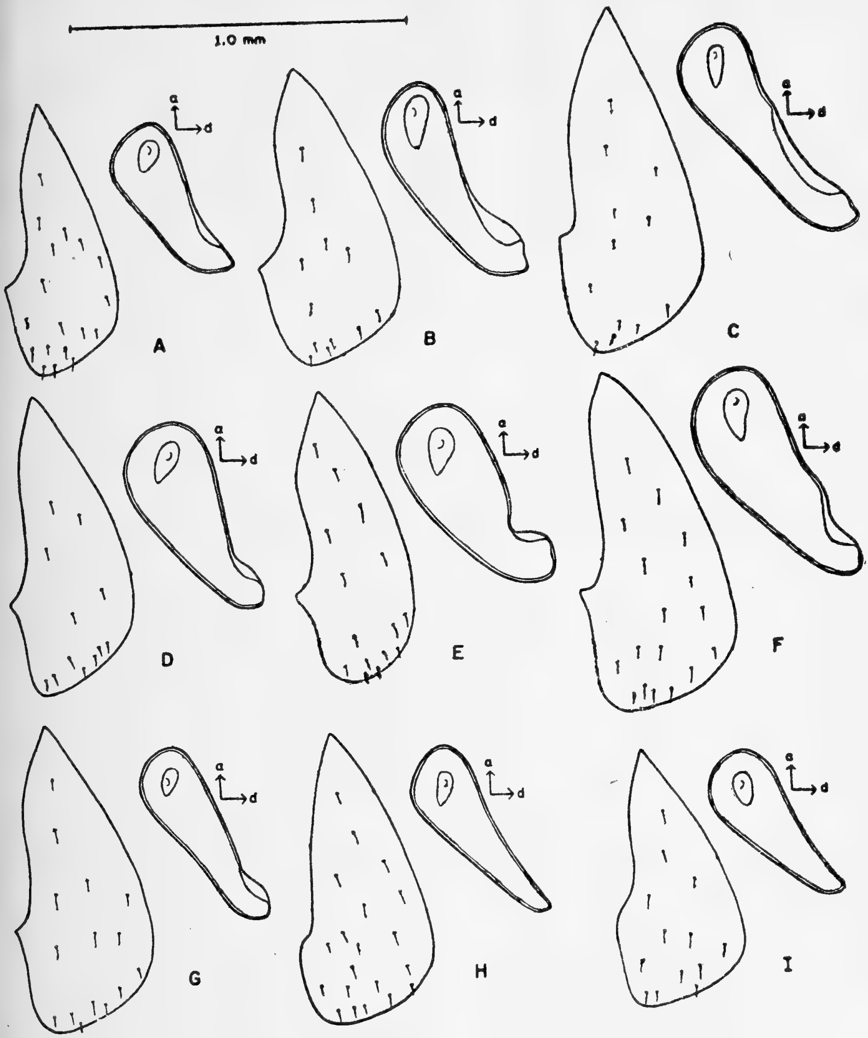

FIG. 2. Adanal shields and spiracular plates. A to G, *R. turanicus* ; H and I, *R. sanguineus*. A and B, from Kashmir, V.R.C. No. A 21882 ; C, also from Kashmir, V.R.C. No. A 23914. D to F, from Poona, V.R.C. No. A 6478 ; G to I, also from Poona, V.R.C. No. A 77940. (a=anterior ; d=dorsal)

F 1 progeny of parents collected off dog on 28 August 1957, at Manjri Stud Farm, Poona, A 6478. Andhra Pradesh : 8 ♂♂, 9 ♀♀, A 48212, off Jungle Cat, 16 July 1961. Madras : 1 ♂ (reared from nymph), A 59381 ; 2 ♂♂, 2 ♀♀ (reared from nymphs), A 59382 ; 1♂, 1 ♀ (reared from nymph), A 59466 all from *Rattus rattus rufescens*, December 1962, Venkatapuram, North Arcot district.

R. sanguineus. Maharashtra: 1 ♂, 2 ♀♀, A 34056, dog, Ganeshkhind, Poona, 12 April 1961; 5 ♂♂, 6 ♀♀ Lab. No. 341, (F 1 progeny of parents collected off dog on 12 September 1961, at Shewalwadi, Poona, A 34074).

As the illustrations show, there is considerable degree of variation in the shape of the adanal shields and the spiracular plates between the two extremes. While further work, including laboratory rearing and studying variations in the progeny of single female is in progress, this brief note is being presented solely with a view to alert the Indian workers on ixodid ticks to re-identify the *R. sanguineus* in their collections in order to determine its true identity, and look out for the presence of *R. turanicus.*

VIRUS RESEARCH CENTRE,[1]
POONA-1,
April 19, 1968.

VIJAI DHANDA
T. RAMACHANDRA RAO

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20. *SYSTROPUS OPHIONEUS* WESTWOOD (DIPTERA: BOMBYLIDAE) AS A PARASITE OF SLUG CATERPILLARS (LEPIDOPTERA: LIMACODIDAE) IN INDIA

(With a plate)

Two slug caterpillars (Lepidoptera: Limacodidae) were collected at Kalimpong, Darjeeling District, West Bengal, on the 7 November, 1962, on an unidentified plant at an altitude of 3900 ft. These larvae

[1] The Virus Research Centre is jointly maintained by the Indian Council of Medical Research and the Rockefeller Foundation. The Centre also receives a grant (3×4307) of the PL 480 Funds from the National Institutes of Health, USPHS, through the Indian Council of Medical Research.

formed cocoons on 8 and 15 November, 1962, respectively. These cocoons were brought down to Delhi in January, 1963, and kept under observation in an airconditioned room maintained at a temperature of about 74°F. About six months after the formation of the cocoons (on 10 and 15 May, 1963, respectively) a male and a female parasite emerged out of the two cocoons instead of the expected limacodid moths. The parasites were identified as *Systropus ophioneus* Westwood (Diptera: Bombylidae).

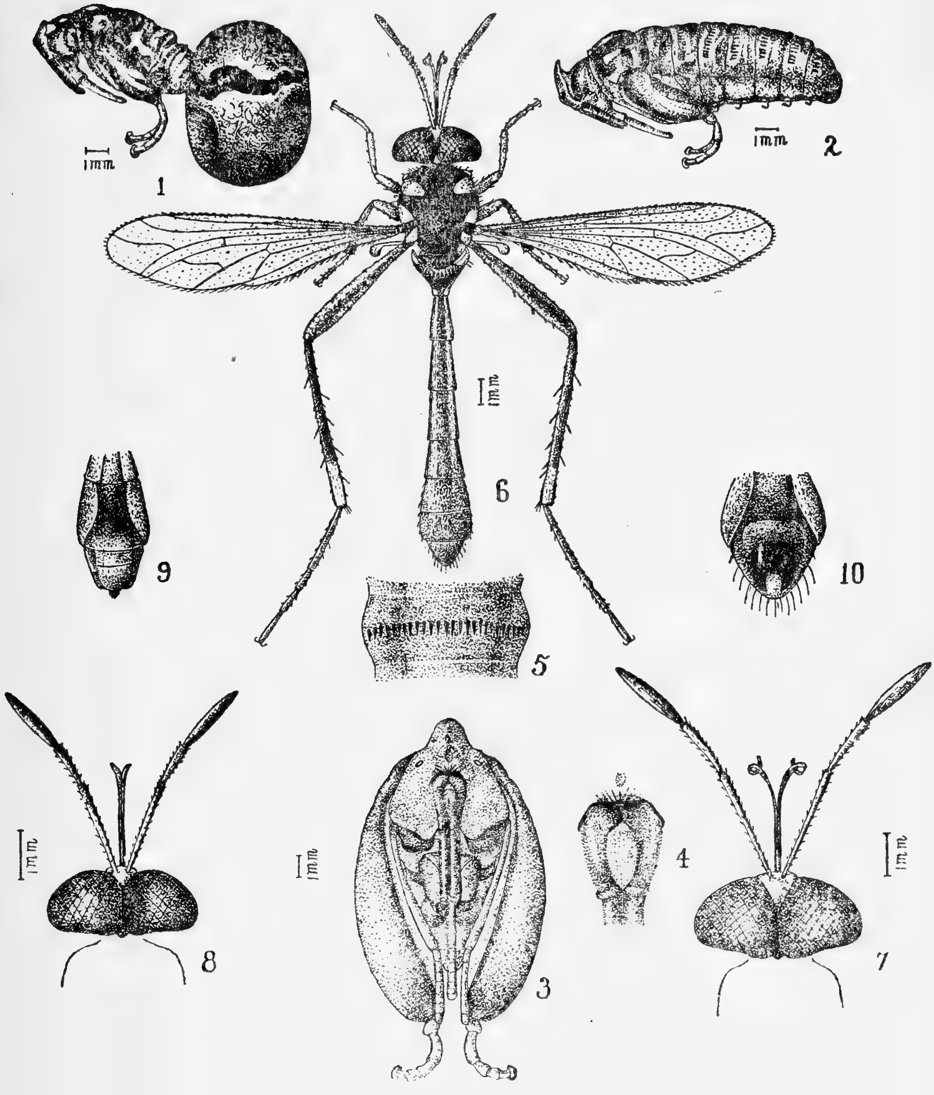
Westwood (1876) recorded five species of *Systropus* from different countries of Asia, namely, *S. ophioneus* Westwood and *S. eumenoides* Westwood from India, *S. polistoides* Westwood from Siam, *S. sphegoides* Walker from Celebes and *S. tipuloides* Westwood from Malaya. Brunetti (1909) besides mentioning *S. blumei* Voll. and *S. tessalatus* Voll. from Java and Sumatra, respectively, added a new species, *S. nigricaudus* from Sikkim, Nepal and Mussoorie. Since then three more species were recorded from the Oriental region, namely, *S. roepki* de Meyer (1914) from Java, *S. hoppo* Matsumara (1918) from Formosa and *S. varipes* Edwards (1919) from Sumatra. Brunetti (1920) added two more species *S. edwardsi* and *S. flavipleura* from Burma and Assam. He also showed that *S. nigricaudus* erected by him as a new species in 1909 was a synonym of *S. ophioneus* Westwood. *S. studyi* Enderlein (1926) was recorded from South China. The above mentioned species, so far recorded from this region, have all been taken as adults only and nothing is on record regarding their larval habits.

The African species, *S. crudalis* Westwood had been recorded by him as having been taken from inside the cocoon of a limacodid, probably of the genus *Parasa* from Natal. Kunckel D'Herculais (1905) described the pupa of *S. conopoides* taken from the cocoon of the limacodid, *Sibine bonaerensis*. Corbett (1933) reported a *Systropus* sp. from the cocoon of the limacodid, *Chalcoscelis albiguttata* Snellen, a pest of coconut in Malaya. More recently Allen & Bull (1954) recorded another *Systropus* sp. (near *tessemanni* Enderlein) parasitising cocoons of a *Parasa* sp. (near *serratilinea* B. B.) and another *Parasa* sp. both pests of oil palms (*Elasis guinensis*) in Nigeria. No further record of parasitism of *Systropus* is available.

The following observations have been made on *S. ophioneus* that have been reared out by the authors. Since it has been the larvae of the limacodid that have been collected from the field and there was no chance of any adult parasites having entered the cages in which they made their cocoons and pupated, the parasitisation must have been definitely during the larval stage of the host. The pupa of *S. ophioneus* possesses similar interesting morphological features with minor differences in detailed structure as noted by Westwood in *S. crudalis*. The frons of the pupa of *S. ophioneus* possesses a strongly sclerotised more or less semilunar ridge at the base of the antennal sheath instead of a frontal conical projection as in *S. crudalis* and a short longitudinal ridge at the middle of the semi-lunar ridge (Figs. 3 & 4). The antennal case in *crudalis* has been described as a long appendage extending along the breast as far as the first ventral segment and its basal half grooved along the middle as though it consists of two halves. In *ophioneus* the two antennal sheaths are quite distinct extending beyond the prothoracic sternum. The flagellar portions of the antennal case, except at the tip, are approximated and held close to one another by a membrane forming a longitudinal groove in the middle. The sheath of the proboscis extends up to the base of the sheaths of hind legs. The sheaths of the forelegs are very short, lying close to one another, and their distal ends are pointed. The sheaths of the middle legs are elongated and extend up to the posterior extremity of the wing covers and the sheaths of the hind legs are covered with the posterior ends of wing covers excepting the posterior extremity of the tibiae and tarsal segments as in *crudalis*. The abdominal segments, excepting the last, are provided on each side of the pleurites with curved spines, the tips of which point cephalad. The dorsal surface of each segment, except that of head and prothorax, is provided with a transverse row of minute straight spines pointing caudad (Figs. 2 and 5).

The semilunar frontal ridge obviously helps the parasite to burst open the operculum of the host cocoon. It also indicates that the parasite pupa has a certain amount of mobility and they are not completely quiescent. The dorsal spines and the lateral spines enable the wriggling pupa to propel itself forward out of the host cocoon and to have a hold on the cocoon which is usually fixed hard to the substratum on which the limacodid pupates, at the time of emergence of the parasite, respectively. As one of the adult parasites emerged after the pupa had wriggled out of the host cocoon, it indicates that the lateral spines in such case help the pupa in getting a hold on the walking surface for the emergence of the adult. Normally, however, the adult parasite emerges when the parasite pupa breaks open the operculum of the host cocoon and holds on the opening (Fig. 1). The adult parasite emerges out of its pupa through rupture of the head and prothorax.

The time taken for the parasite to complete its life history from parasitisation to emergence also indicates that the parasite has a



Systropus ophioneus Westwood

1. Pupal exuiviae attached to limacodid cocoon showing nature of emergence; 2. Lateral view of pupa; 3. Ventral view of anterior part of pupa; 4. Frontal ridge of pupa; 5. Dorsal row of spines on abdominal segment; 6. Adult female; 7. Dorsal view of head of adult female; 8. Dorsal view of head of adult male; 9. Terminal end of abdomen of adult female; 10. Terminal end of abdomen of adult male.

single brood in a year and that the adult parasite emerges when the host larvae are present in the field. Since particularly the entire host pupa had been eaten up by the parasite larva and only insignificant part of the host pupal covering was left in the cocoon, it is evident that the parasite larva pupates after consuming the host pupa.

ACKNOWLEDGEMENTS

The authors are grateful to Dr. S. Pradhan, Head of the Division of Entomology, Indian Agricultural Research Institute, New Delhi, for encouragement during the work and for providing facilities for work.

Thanks are also due to Shri A. K. Roy, Artist, Division of Entomology, Indian Agricultural Research Institute, New Delhi, for preparing the drawings reproduced here.

INDIAN AGRICULTURAL RESEARCH INSTITUTE,
NEW DELHI,
November 6, 1967.

M. G. RAMDAS MENON
S. N. CHATTERJEE
Systematic Entomologists.

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21. PRELIMINARY STUDIES ON THE BIOLOGY OF *GRAPTOSTETHUS* SP. (LYGAEIDAE, HEMIPTERA) FEEDING ON STUBBLES OF SANNHEMP

Fletcher (1914)[1] reported *Graptostethus servus* Fabr., for the first time in India. The nymphs and adults were reported by him to feed on red gram, sweet potato and jute capsules.

During March 1966 large numbers of nymphs and adults, of *Graptostethus* sp. were found feeding on the stubbles of Sannhemp at

[1] FLETCHER, T. B. (1914): Some South Indian Insects and other animals of importance, pp. 482. Govt. Press, Madras.

the R. A. K. Agriculture College, Sehore, M. P. farm, and the biology of the pest was studied.

Mating:

Mating end to end occurred soon after emergence of adults. A single act of copulation took a maximum of 150 minutes and a minimum of 20 minutes. Females mate several times during their life time.

Preoviposition and Oviposition:

Eggs are laid on the seeds singly and rarely in clusters of 3 to 5. If the male dies, the egg laying capacity of the female decreases but on release of a fresh male with the female the fecundity increases.

The total number of eggs laid by a female varied from 46 to 136. The oviposition period ranged from 4 days in April upto 9 days in March. Maximum number of eggs laid by a single female in a day was 28.

TABLE 1

OVIPOSITION PERIOD AND FECUNDITY OF *Graptostethus* sp.

Month		Oviposition period (in days)	No. of eggs laid by a female
March 1966	..	9	136
April 1966	..	4	46

Incubation period and hatching:

The incubation period ranged from 3 to 7 days. The pinkish colour of the egg darkened at the time of hatching. A few hours before hatching a reddish point developed at the anterior end of the egg indicating the presence of head and compound eyes. During hatching the egg shell opened out at the anterior end allowing a lid-like portion of the egg to separate out. First the head of the larval nymph emerges followed by the rest of the body. The whole sequence of hatching was completed within 10-12 minutes. The percentage viability of the eggs varied from 74 to 89.

Nymphal instars:

The developmental periods of five nymphal instars were 3, 3, 2 to 3, 3 to 4 and 3 to 5 days respectively. The total duration of nymphal period ranged from 15 to 17 days both in males and females,

TABLE 2

INCUBATION PERIOD AND PER CENT VIABILITY OF EGGS OF *Graptostethus* sp.

Date of egg laying	No. of eggs under observation	Date of hatching	No. of eggs hatched		Incubation period (in days)	per cent viability
25-iii-66	100	29-iii-66 30-iii-66 31-iii-66 1-iv-66	57 13 9 7	86	4-7	86
30-iii-66	100	2-iv-66 3-iv-66	59 15	74	3-4	74
3-iv-66	100	8-iv-66 9-iv-66	69 18	87	5-6	87
15-iv-66	100	20-iv-66 21-iv-66	73 16	89	5-6	89

TABLE 3

DURATION OF NYMPHAL PERIOD

Date of hatching	Date of 1st moult	Date of 2nd moult	Date of 3rd moult	Date of 4th moult	Date of 5th moult	Nymphal period (in days)
31-iii-66	3-iv-66	6-iv-66	8-iv-66	12-iv-66	15-iv-66	15
3-iv-66	6-iv-66	9-iv-66	12-iv-66	15-iv-66	20-iv-66	17

Life cycle and longevity of adults:

The period required for one life cycle varied from 17 to 24 days. The longevity of male and female adults with food varied from 3 to 4 and 6 to 11 days respectively.

TABLE 4

LIFE CYCLE PERIOD AND LONGEVITY OF ADULTS

Date of egg laying	Date of hatching	Incubation period (in days)	Date of formation of adult	Nymph. period (in days)	Total period for life cycle	Date of mortality	Longevity in days
25-iii-66	1-iv-66	7	18-iv-66	17	24	♂ 22-iv-66 ♀ 24-iv-66	4 6
27-iii-66	30-iii-66	3	16-iv-66	17	20	♂ 20-iv-66 ♀ 27-iv-66	4 11
30-iii-66	2-iv-66	3	16-iv-66	14	17	♂ 19-iv-66 ♀ 24-iv-66	3 8

Description of Life History stages

Egg

Average of 10 eggs—length 0·99 mm., breadth 0·52 mm. Elongate, colour uniformly pinkish.

Nymph

First Instar: Average of 10 nymphs—length 1·28 mm. breadth 0·49 mm. Freshly hatched nymph uniformly faint yellow, with head, eyes, legs and antennae brownish. Antenna four segmented, the distal segment pinkish in colour. Brownish spots on the thoracic region. Three red stripes on the dorsum of the abdomen one located in the centre and two on lateral sides of the abdomen. Hair all over the body.

Second Instar: Average of 10 nymphs—length 2·20 mm., breadth 1·15 mm. Body colour similar to that of first instar nymph. Red irregular spots appear in between the red stripes on the dorsal part of the abdomen.

Third Instar: Average of 10 nymphs—length 2·39 mm., breadth 1·15 mm. The colour of the head, eyes, antennae and legs become blackish brown. Head and thorax well sclerotized. Red stripes of the abdomen become prominent. Irregular red dots continue. Abdomen pale yellow. Two black spots develop on the central red stripe, first on the tergites of 4th and 5th and second on tergites of 5th and 6th abdominal segments towards their posterior part. Anal end black.

Table 5

Measurements of various developmental stages of *Graptostethus* sp. in mm.

Stage	Variations in		Average	
	Length (mm.)	breadth (mm.)	Length (mm.)	breadth (mm.)
Egg ..	0·99-1·10	0·52-0·55	0·99	0·52
First Instar ..	0·90-1·22	0·42-0·54	1·28	0·49
Second ,, ..	1·80-2·34	0·83-1·33	2·20	1·15
Third ,, ..	2·16-2·70	1·00-1·44	2·39	1·15
Fourth ,, ..	2·95-3·60	1·62-1·80	3·82	1·66
Fifth ,, ..	5·00-6·00	2·50-4·50	5·24	3·13

Fourth Instar: Average of 10 nymphs—length 3·82 mm., breadth 1·66 mm. Body colour darkens. The two black spots become prominent. Wing pad starts developing, extending up to half of the first abdominal segment. A white line develops in the centre running longitudinally on the dorsal part of the abdomen bisecting it.

Fifth Instar: Average of 10 nymphs—length 5·24 mm., breadth 3·13 mm. Body colour further darkens. Head thorax and legs well sclerotized, wing pads extended up to second abdominal segment.

Adult

Average of 10 adults—length 5·85 mm., width across the wings 3·38 mm. Body colour greyish brown or smoky. Antennae, mouth parts and legs black. Antennae four segmented, pronotum small, Mesonotum largest with black spots, Scutellum black.

ACKNOWLEDGEMENTS

The authors record their grateful acknowledgement to Dr. T. R. Subramaniam, Entomologist, Agricultural College, Madurai, for the identification of the insect and also to Shri H. P. Dwivedi, Principal, R. A. K. Agriculture College, Sehore, M.P., for providing necessary facilities.

DEPARTMENT OF ENTOMOLOGY,
COLLEGE OF AGRICULTURE,
GWALIOR, M.P.,
November 28, 1967.

S. V. DHAMDHERE
R. R. RAWAT

22. EARTHWORM CASTS AS A SOURCE OF MUD FOR THE CONSTRUCTION OF NEST BY SPHECID WASP

In the Malabar Christian College compound, when the authors were engaged in the collection of certain insects, an unidentified Sphecid wasp, about an inch in length was found frequenting a spot on the ground in the area. On closer examination, it was found that it was hovering around the earthworm casts. It landed on a few casts, apparently 'testing' the consistency or suitability of the mud and finally settled down on a particular cast. A small bit of mud was then bitten off with the mandibles and was beautifully kneaded into a spherical mass, about a quarter of an inch in diameter. The wasp then flew away, carrying the mass of mud with the help of the anterior two pairs of legs. It was naturally inferred that the wasp was using this mud for the construction of its mud-nest.

The wasp returned to the same site after about ten minutes and repeated the process. It first flew around, touched a few objects and casts and finally chose the same cast for kneading the mud-ball. It is presumed that the wasp, during the construction of its nest, flies out in search of a suitable earthworm cast and that, after having found one, marks the cast and the objects around and leading to the nest with trail marking pheromones which guide it, perhaps also along with the visual landmarks, repeatedly to the same cast.

Casual observations made for a few days (September 12-16, 1967) revealed that the number of visits made by the wasp to the cast is much greater in the forenoon than in the afternoon. This may be because the fresh casts are moist and softer in the forenoon. The fresh and moist worm casts are sticky and fine grained and should constitute a very good and convenient source of mud for the construction of the wasp's nest.

DEPARTMENT OF ZOOLOGY,
MALABAR CHRISTIAN COLLEGE,
CALICUT-1,
July 14, 1968.

A. B. SOANS
J. S. SOANS

23. STUDIES ON INDIAN ICHNEUMONIDAE (HYMENOPTERA PARASITICA)

(With a text-figure)

This paper describes species belonging to the vipionid genus *Apanteles* collected from the Marathwada region of Maharashtra State and contains new records of eleven species and the description of a new species, *Apanteles parbhanii*. Host species are mentioned, as far as possible, to make the paper more useful for ready reference. I take this opportunity to thank Dr. Mehdi Ali, Professor of Zoology and the authorities of the Marathwada University, for all facilities in the preparation of this paper.

The type specimens and the slides are presently in the collections of the author and will be deposited in the collections of the Zoological Survey of India.

Apanteles bosei Bhatnagar 1948

MATERIAL : 1♀ SNR Coll., at light, Aurangabad, 14.ix.66.

Distribution: Bihar.

Hosts: *Amsacta moorei* (Butl.). *A. lineola* Fabr., (Arctiid moths).

Apanteles calycinae Wilkinson 1928

MATERIAL : 1♂ SNR Coll., at light, Aurangabad, 9.vii.1966.

Distribution: Dehra Dun (U.P.), Thana District (Maharashtra), and Pusa (Bihar).

Host: *Acrocercops supplex* Meyr. (Lithocolletid moth).

Apanteles exelastisae Bhatnagar 1948

MATERIAL : 1♂ SNR Coll., at light, Aurangabad, 20.xi.65.

Distribution: Agra (U.P.), Pusa (Bihar).

Host: *Exelastis liophanes* Meyr.

Apanteles flavipes (Cameron 1891)

MATERIAL : 1♂ SNR Coll., at light, Aurangabad, 28.viii.66.

Distribution: Poona (Maharashtra), Pusa (Bihar), Delhi and Lower Burma.

Hosts: *Argyria sticticraspis* (Hamp.), *Cirphis unipunctata* (Haw.), *Chilo simplex* (Butl.), *Syrphus* sp.

Apanteles glomeratus (Linn. 1758)

MATERIAL : 1♂, 1♀ ; SNR Coll., at light, Aurangabad, 14.ix.66.

Distribution: Dehra Dun (U.P.), Pusa (Bihar), Shillong (Assam), Europe, America.

Host: *Pieris brassicae* L.

Apanteles jhaverii Bhatnagar 1948

MATERIAL : 1♂ SNR Coll., at light, Aurangabad, 14.ix.1966.

Distribution: Dhulia (Maharashtra).

Host: Noctuid moth, *Cosmophila erosa* (Hübn.).

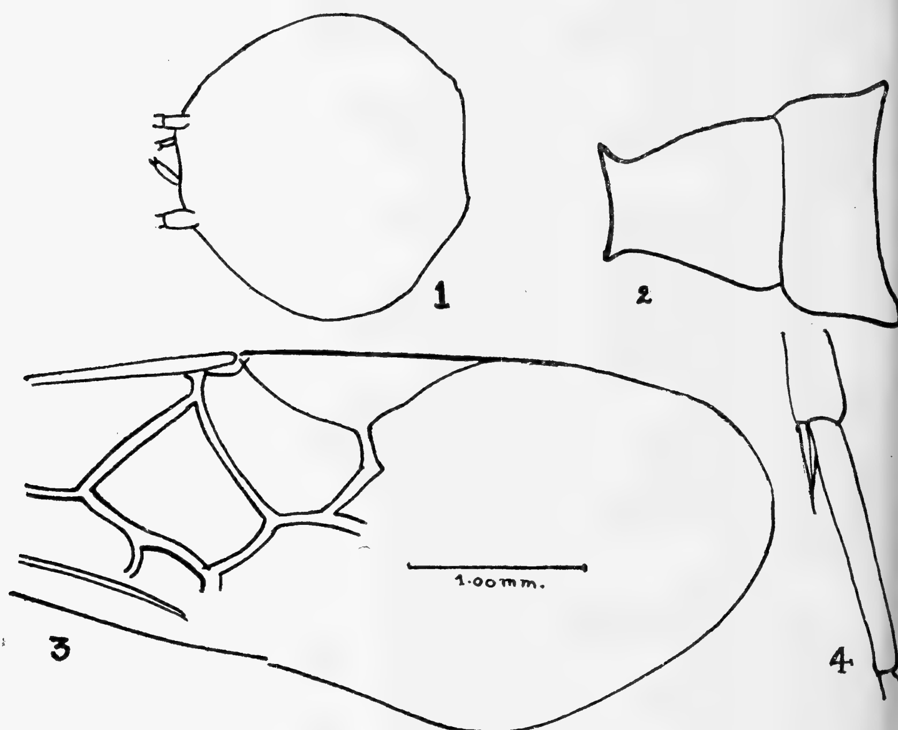
Apanteles longitergiae Rao & Kurian, 1950

MATERIAL : 1♀ SNR Coll., at light, Aurangabad, 4.iii.66.

Distribution: Agra (U.P.)

Apanteles parbhanii sp. nov.

♂ ♀ Black. Head viewed from above: half as long as wide, inter-orbital space three-fifths the width of the head; inter-ocellar space three-fifths the ocellocular, front ocellar space less than half the inter-ocellar, dark blackish-brown, very faintly punctate, occiput slightly concave, smooth and shining; viewed from front (fig. 1) fully circular, face below antennae sparsely setose, minutely punctate, inner orbital border straight, inter-orbital space uniform, eyes naked; viewed from side: nearly half as deep as high, post-orbital space less than half the depth of head. Antennae blackish-brown, longer than body with 18 segments, inserted in the middle of face, antennal segments cylindrical, with a band-like constriction in the middle. Palpi pale yellow, quadriarticulate.



Figs. 1. Head front view; 2. Anterior part of abdomen; 3. Fore wing; 4. Hind tibia with spurs.

Thorax black, depressed, wider between the tegulae than high, slightly wider than head, mesonotum coarsely punctate, posteriorly more shallowly, scutellum with indistinct punctae, almost smooth, tegulae black, propodeum with a median longitudinal carina, mesopleura nearly smooth. Wings (fig. 3) hyaline, two and a half times as long as broad, fairly setose, veins pale blackish-brown, pterostigma of the same colour as the veins, slightly shorter than R_1, r a little more than half the breadth of pterostigma, four-fifths the length of $r—m$, equal to M_1+2, $r—m$ slightly shorter than M_3+4, legs yellow, hind coxae black for the proximal three-fourths, apical quarter yellow, nearly smooth, extreme tip of tibiae and tarsi slightly darker, rest of the legs yellow; hind tibiae with two unequal spurs (fig. 4), longer spur nearly one-third the length of metatarsus, shorter spur four-fifths the longer spur.

Abdomen (fig. 2) as long as thorax, first tergite pale black, coarsely and irregularly punctate, broadest at apex, length a little more than the maximum breadth, second tergite yellow, not as long as but broader than first, more sparsely punctate than first, rest of the tergites black, smooth, dull. Ovipositor short.

Length both sexes 1·88 mm.

Holotype one female and *allotype* one male on slides and paratypes both males and females in spirit labelled 'Reared from cocoons collected on Jowar plant, Parbhani Agricultural College Fields, 9-x-1966, collected by students and Rao'.

Host: Cirphis unipunctata (Haw.)

This species does not agree with either *A. cirphicola* Bhat. (1948) or *A. flavipes* (Cameron 1891). It differs from the former in the details of the head, thorax and wing and also the scutellum being rugosely punctate. This species also differs from the latter in the details of the wing and thorax and is differentiated from *A. rufficrus* (Haliday 1835), another parasite of the same host on the same plant in the presence of the propodeal costulae.

Apanteles platyptilliae Rao & Kurian

MATERIAL : 1♂ SNR Coll., on wing, Aurangabad, 10.x.66.

Distribution: Pusa (Bihar).

Host: Platypilia taprobanus.

Apanteles ricini Bhatnagar 1948

MATERIAL : 1♂ SNR Coll., on wing, Aurangabad, 10.iii.66.

Distribution: Travancore (Kerala).

Host: Arctiid moth, *Arctia* (*Pericallia*) *ricini* (Fb.)

Apanteles ruficrus (Haliday 1835)

MATERIAL : 1♂ SNR Coll., on wing, Aurangabad, 15.iii.66.

Distribution: This cosmopolitan species was previously recorded from a number of places in India: Agra, Dehra Dun (U.P.), Coimbatore (Madras), Cuttack (Orissa), Hyderabad (A.P.).

Hosts: The species has a very wide range of hosts: *Cirphis loreyi* (Dup.), *C. unipunctata* (Haw.), *Heliothis armigera* (Hubn.), *Hypsipyla robusta* (Moore), *Naranga diffusa* (Walk.), *Perigea capensis* (Guen.), *Phytometra* sp., *Plusia orichalcea* (Fabr.), *Sesamia calamistis* (Hmpsn.), *S. cretica* (Led.), *Spodoptera mauritia* (Boisd.).

Apanteles taprobanae (Cameron 1891)

MATERIAL : 2♀♀ SNR Coll., on wing, Aurangabad, 27.xi.1966, (in spirit).

Distribution: Pusa, Ranchi (Bihar), Bangalore (Mysore), Ceylon, Formosa, Java.

Host: *Stauropus alternus* (Walk.).

READER IN ZOOLOGY,
MARATHWADA UNIVERSITY,
AURANGABAD,
July 4, 1967.

S. N. RAO

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24. A NEW VARIETY OF *CROTALARIA MADURENSIS* FROM SOUTH INDIA

(With a plate)

Crotalaria madurensis Wt. var. **kurnoolica** Ellis et Swamin. var. nov.

Affinis var. *madurensi*, a qua differt bracteis et bracteolis majoribus, revolutis, persistentibus; calycis lobis connatis prope basin, aequalibus, eminenter revolutis.

Herbae altae vel suffrutices; caules valde ramosi, teretes, luteolo-sericeo-pubescentes. Folia simplicia, alterna, exstipulata, elliptica, ovata vel obovata, apiculata, angusta ad basin, breviter petiolata; petiolis 0·4 cm. longis, dense luteo-brunneo-sericeo-pubescentibus; lamina 7·5×3·0 cm., luteo-sericeo-pubescens in utraque pagina; nervorum lateralium ad 14 juga, supra impressa, paulum elevata infra. Flores terminales vel axillares, paniculati, racemosi, bracteati, bracteolati; pedunculis ad 15 cm. longis, dense luteo-brunneo-sericeo-pubescentibus; bracteis plus minusve 1·0×0·6 cm., late ovatis, acuminatis, alte cordatis, amplexicaulibus, trinervis, revolutis, luteo-sericeo-pubescentibus extus, glabris intus, persistentibus; bracteolis 0·5×0·3 cm., ovatis, acuminatis, alte cordatis, trinervis, revolutis, luteo-sericeo-pubescentibus extus, glabris intus, persistentibus. Calyx alte lobatus, lobis prope basin connatis, aequalibus, 0·9×0·4 cm., ovatis, ellipticis, angustatis ad apicem, cordatis ad basin, trinervis, eminenter revolutis, dense luteo-brunneo-sericeo-pubescentibus extus, glabris intus, fuscis cum siccis; nervis lateralibus reticulatis versus margines. Corolla lutea; vexillum 2 cm., aeque latum ac longum, pilosum extus et ad margines, glabrum intus, nervis reticulatis; alae vexillo breviores, unguiculatae, et plicis minutis transveris intus ornatae, glabrae; carina rostrata, alis aequilonga, pilosa extus et ad margines usque ad medium. Stamina 10, dimorpha, monadelpha per dimidiam longitudinem, eorum 5 parva sterilia alternantia fertilibus magnis quinque; antherae fertiles basifixae; antherae steriles paulum versatiles. Ovarium breviter pedicellatum, dense pubescens, stylo longo, abrupte incurvato ad basin, stigmate parvo, pilis minutis circum distributis. Fructus ignotus.

Holotypus *Ellis 22144 A* lectus ad Srisailam, Nallamalais, Kurnool distr. in ditione Andhra Pradesh, 21-10-1964, positus in CAL; isotypi *Ellis 22144 B-E* in MH.

Crotalaria madurensis Wt. var. **kurnoolica** Ellis & Swamin., var. nov.

Allied to var. *madurensis* but differs in having bracts and bracteoles bigger, revolute, persistent; calyx lobes connate near the base, equal, prominently revolute.

Tall herbs or undershrubs; stems much branched, terete, yellowish-silky-pubescent. Leaves simple, alternate, exstipulate, elliptic, ovate or obovate, apiculate, narrowed at base, shortly petioled; petiole 0·4 cm. long, densely yellowish-brown-silky-pubescent; lamina 7·5×3·0 cm., yellowish-silky-pubescent on both surfaces; lateral nerves upto 14 pairs, impressed above, slightly raised below. Flowers in terminal or axillary panicled racemes, bracteate, bracteolate; peduncle up to 15 cm. long, densely yellowish-brown-silky-pubescent; bracts 1·0×1·6 cm., broadly ovate, acuminate, deeply cordate, amplexicaul, tri-nerved, revolute, yellowish-silky-pubescent without, glabrous within, persistent; bracteoles 0·5×0·3 cm., ovate, acuminate, deeply cordate, tri-nerved, revolute, yellowish, silky-pubescent without, glabrous within, persistent. Calyx deeply lobed; lobes connate near the base, equal, 0·9×0·4 cm., ovate, elliptic, narrowed at apex, cordate at base, tri-nerved, prominently revolute, yellowish-brown, densely silky-pubescent without, glabrous within, dark when dry; the lateral nerves reticulate towards the margins. Corolla yellow; standard 2 cm., as broad as long, hairy without and on the magins, glabrous within, nerves reticulate; wings shorter than standard, clawed and with minute transverse folds within, glabrous; keel beaked, as long as wings, hairy without and on the margins up to the middle. Stamens 10, dimorphic, monadelphous till half their lengths, 5 small sterile alternating with 5 big fertile; fertile anthers basifixed; sterile anthers slightly versatile. Ovary shortly stalked, densely pubescent; style long, abruptly incurved at base; stigma small with minute hairs all round. Fruits not seen.

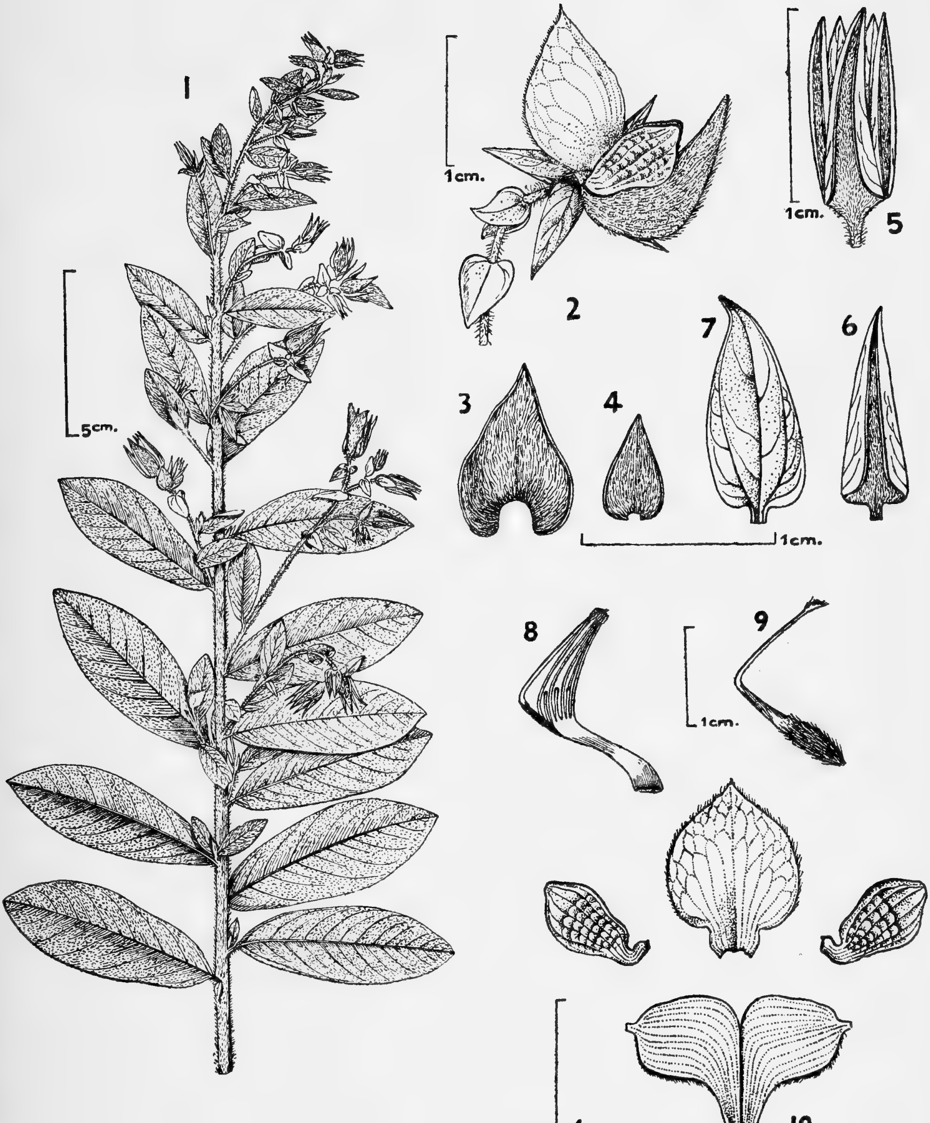
Holotype *Ellis 22144 A* (Srisailam, Nallamalais, Kurnool District, Andhra Pradesh, 21-10-1964) is placed in CAL; isotypes *Ellis 22144 B-E* in MH.

ACKNOWLEDGEMENTS

We are thankful to the Director, Royal Botanic Gardens, Kew, Surrey, England, for comparing this plant with related plants in the Kew Herbarium and giving his valuable opinion. We are indebted to Rev. Fr. Dr. H. Santapau, S.J., Director, Botanical Survey of India, Calcutta, for Latin translation. Thanks are also due to late Dr. K. M. Sebastine, Regional Botanist, Botanical Survey of India, Coimbatore, for his keen interest and kind encouragement.

SOUTHERN CIRCLE,
BOTANICAL SURVEY OF INDIA,
COIMBATORE,
April 10, 1968

J. L. ELLIS
M. S. SWAMINATHAN



Crotalaria madurensis Wt. var. *kurnoolica* Ellis et Swamin.

1. Flowering branch; 2. Flower; 3. Bract (lower surface); 4. Bracteole (lower surface); 5. Calyx; 6. Sepal (below); 7. Sepal (above); 8. Staminal tube with enclosed pistil; 9. Pistil; 10. Petals (diagrammatic).

25. A NEW VARIETY OF *PERISTROPHE BICALYCULATA* (RETZ.) NEES, FROM W. BENGAL

Peristrophe bicalyculata var. **subaequibracteata** var. nov.

A var. *bicalyculata* differt cymulis nullo vel unico flore rudimentario ornatis, bracteis involucralibus cymularum subaequalibus et lanceolatis vel lineari-lanceolatis.

Holotypus, *Bennet 1065 A*, et isotypus, *Bennet 1065 B*, lecti die 2-1-1965 ad Syampur, in dist. Howrah et positi in CAL.

Peristrophe bicalyculata var. **subaequibracteata** var. nov.

Differs from var. *bicalyculata* in having flower-clusters (cymules) without or rarely with 1 rudimentary flower, and all the involucral bracts of flower-clusters being subequal and lanceolate to linear-lanceolate.

Holotype, *Bennet 1065 A* and Isotype, *Bennet 1065 B* have been collected on 2-1-1965, from Syampur, Howrah district and deposited in Central National Herbarium, Calcutta.

The author expresses his thanks to Dr. C. E. B. Bremekamp of Netherlands for his valuable opinion regarding the specimen, and to Rev. Fr. H. Santapau for Latin translation.

BOTANICAL SURVEY OF INDIA,
CALCUTTA-14, S. S. R. BENNET
January 10, 1969.

26. A NEW SPECIES OF *BECCARIANTHUS* COGN. (MELASTOMATACEAE)

(*With a plate*)

Beccarianthus robustus sp. nov.

B. pulchro Cogn. proximus, sed floribus calycibusque majoribus, lobis calycinis longioribus, anguste triangularibus acuminatis differt.

Arbor 6 m. alta. *Ramuli* angulati, juveniles dense paleacei vel papillosi. *Folia* lanceolata vel lanceolato-elliptica, 25-30×5·5-10 cm., cuneata ad basin, acuminata ad apicem, margine integra, infra et supra scabra, subtus ad nervos papillosa, 5-nervia, venulis transversis distinctis; petiolus robustus, 4-6 cm. longus, dense papillosus. *Inflorescentia* 6-8 cm. longa, dense papillosa; flores magni, in cymas breves terminales dispositi; bracteolae lanceolatae 14-15 mm. longae, dense furfuraceae; pedicellus 5-10 mm. longus. *Calycis tubus* campanulatus, 13-14 mm. longus, dense papillosus, limbus 5-lobatus, lobis triangularibus, 10-11 mm. longis, acuminatis. *Petala* 5, oblonga, 20-22×9-11 mm., glabra, carnosula. *Stamina* 10, aequalia, filamentis 17-19 mm. longis, antheris oblongis, 4-5 mm. longis, connectivo basi non producto et inappendiculato. *Ovarium* calycis tubo totum adnatum, 5-loculare; placentis angulo inferiori loculorum affixis; stylus 3-3·5 cm. longus, glaber, gracilis, stigmate punctiformi. Fructus ignotus.

Typus lectus a Kalkman ad locum Beriat (alt. 10 m.,) in Nova Guinea die 20 aprilis 1958, et positus in Herb. Kew, Anglia, subnumero *Kalkman* BW 6260; Isotypus positus in Rijksherbario in urbe Leiden sub numero *Kalkman* BW 6260.

Beccarianthus robustus sp. nov.

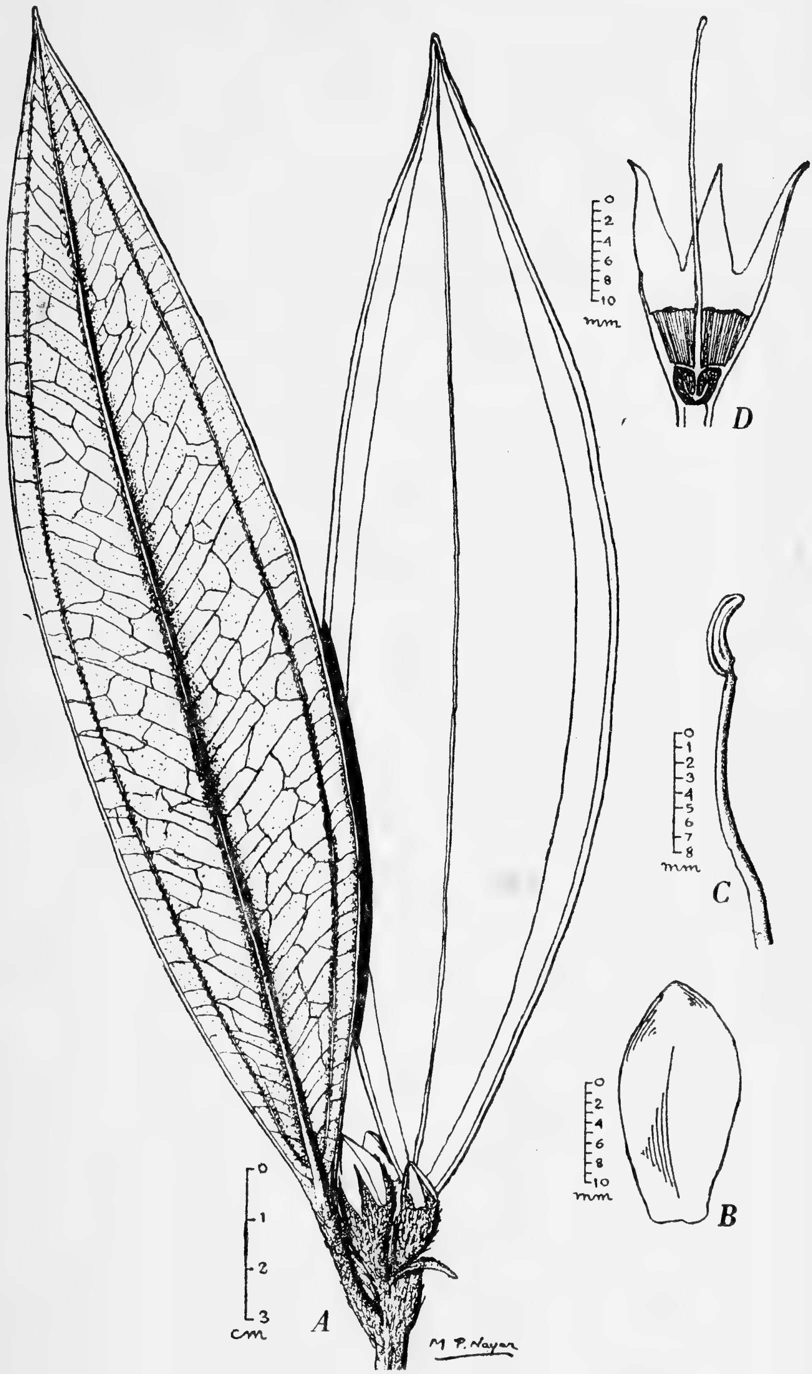
Closely related to *B. pulcher* Cogn. but differs in having larger flowers and calyx tube, longer triangular acuminate calyx lobes.

A *tree* 6 m., in height. *Branches* angular, young branches densely chaffy or scaly or papillose. *Leaves* lanceolate or lanceolate-elliptic, 25-30×5·5-10 cm., base cuneate, apex acuminate, margin entire, upper and lower surface rough to the touch, under surface papillose along the nerves, 5-nerved, transverse venules distinct; petiole strong, 4-6 cm. long, densely papillose. *Inflorescence* 6-8 cm. long, densely papillose; flowers large in short terminal cymes; bracteoles lanceolate 14-15 mm. long, densely furfuraceous; pedicel 5-10 mm. long. *Calyx tube* campanulate, 13-14 mm. long, densely papillose, 5-lobed, lobes triangular, 10-11 mm. long, acuminate. *Petals* 5, oblong, 20-22×9-11 mm., glabrous, somewhat fleshy. *Stamens* 10, equal, filaments 17-19 mm. long, anthers oblong, 4-5 mm. long, connectives not produced and inappendiculate. *Ovary* completely adnate to the calyx tube, 5-chambered; placenta attached to the lower angle of the ovary chamber; style 3-3·5 cm. long, glabrous, slender, stigma punctiform. *Fruit* not known.

Distribution

New Guinea: Beriat, alt. 10 m., 20 Apr. 1958, *Kalkman* BW 6260 (Holotype K, isotype L).

The genus *Beccarianthus* Cogn. is so far known only from the Islands of Borneo and Philippines. The allied species *B. pulcher* Cogn. is confined to Sarawak, Borneo. The present species, *B. robustus* Nayar, occurring in New Guinea extends the generic range of *Beccarianthus* Cogn.



Beccarianthus robustus Nayar sp. nov.

A. Habit. *B.* Petal. *C.* Stamen. *D.* L. S. of calyx tube.

ACKNOWLEDGEMENTS

I wish to express my gratitude to Sir George Taylor, Director, Royal Botanic Gardens, Kew, U.K., for all facilities during my stay at Kew in 1961-67. I am indebted to Prof. Dr. C. G. G. J. van Steenis, Director, Rijksherbarium, Leiden, and to Dr. R. C. Bakhuizen van den Brink for their hospitality during my visit to Leiden in 1965. My thanks are also due to the Director of the Botanical Survey of India, the Rev. Fr. Dr. H. Santapau for his encouragement.

INDUSTRIAL SECTION,
INDIAN MUSEUM, M. P. NAYAR
BOTANICAL SURVEY OF INDIA,
CALCUTTA,
April 8, 1968.

27. NOMENCLATURAL CHANGES IN SOME BOMBAY PLANTS—III

[*Continued from Vol.* **60** (1): 298]

PORTULACACEAE

Talinum portulacifolium (Forsk.) Aschers. & Schweinf. in Bull. Herb. Boiss. iv, App. 172, 1896. *Orygia portulacifolia* Forsk. Fl. Aegypt.-Arab. 103, 1775. *Portulaca cuneifolia* Vahl, Sym. Bot. 1:33, 1790. *Talinum cuneifolium* (Vahl) Willd. Sp. Pl. 2:864, 1799.

MALVACEAE

Hibiscus ovalifolius (Forsk.) Vahl, Sym. Bot. 1:50, 1790. *Urena ovalifolia* Forsk. Fl. Aegypt.-Arab. 124, 1775. *Hibiscus micranthus* Linn. f. Suppl. 308, 1781.

STERCULIACEAE

Guazuma ulmifolia Lamk. Encycl. Meth. Bot. 3:52, 1789; Robyns in Ann. Miss. Bot. Gard. 51:103, t. 7, 1964. *Theobroma guazuma* Linn. Sp. Pl. 782, 1753. *Guazuma tomentosa* H.B.K. Nov. Gen. Sp. Pl. 5:320, 1826.

Papilionaceae

Desmodium dichotomum (Willd.) DC. Prod. 2:336 (Oct.) 1825; Knaap van Meeuven in Reinwardtia 6:248, 1962. *Hedysarum dichotomum* Willd. Sp. Pl. 3 (2): 1180, 1803. *Hedysarum diffusum* Willd. loc. cit. *Desmodium diffusum* (Willd.) DC. Prod. 2:336, (Oct.) 1825, non DC. (Jan.) 1825.

The name *D. diffusum* published by De Candolle in *Ann. Sc. Nat.* 4:100 (Jan.) 1825 and which is quoted in his *Prodromus* 2:335, 1825, is *D. laxiflorum* (Roxb.) DC. That name, therefore, appearing in our Indian floras is not legitimate, being a later homonym. The next valid name is, then, *D. dichotomum* DC., based on *H. dichotomum* Willd.

Onagraceae

Ludwigia adscendens (L.) Hara, J. Jap. Bot. 28:290, 1953; Raven in Reinwardtia 6:387, 1963. *Jussiaea adscendens* Linn. Mant. 1:67, 1767. *Jussiaea repens* Linn. Sp. Pl. 1:388, 1753; Brenan in Fl. Trop. E. Afr. (Onagraceae) 19, 1953.

Though the two Linnaen genera *Ludwigia* and *Jussiaea* have been treated as distinct in our Indian floras, the consensus of modern taxonomists is that they should be combined, as the stamen number is not a constant character. Brenan (*Kew Bull.* 1953:163, 1953) united them under *Jussiaea.* In this he has been followed by Santapau (*Bull. bot. Surv. India* 3:18, 1961) and Raizada (*Ind. For.* 92:315, 1966). However, according to Raven (*Reinwardtia* 6:327-328, 1963), Hara (*J. Jap. Bot.* 28:289-294, 1953 pointed out that Brenan's choice was inconsistent with Art. 57 of the Code. Baillon (*Hist. Pl.* 6:463, 1877) was the first to unite the two under *Ludwigia* and his choice had to be followed. Raven is, therefore, justified, following Hara, in putting all his plants under *Ludwigia.* The earliest basionym is *J. repens* L. 1753, but it cannot be taken up here as the resulting binomial would be a later homonym of *L. repens* Forst. 1771.

Convolvulaceae

Ipomoea mauritiana Jacq. Collect. 4:216, 1791 & in Hort. Schoenber. 2:39, t. 200, 1797; Verdcourt in Fl. Trop. E. Afr. 135, 1963. *Convolvulus paniculatus* Linn. Sp. Pl. 156, 1753. *Ipomoea paniculata* (L.) R. Br. Prod. 486, 1810, non Burm. f. 1768. *I. digitata sensu* Baker & Rendle in Fl. Trop. Afr. 4 (2): 189, 1905; Ooststroom in Fl. Males. Ser. I, 4 (4): 483, t. 55, 1953, non Linn. 1759.

According to Verdcourt the Type of *I. mauritiana* Jacq. is a plant from Mauritius cultivated at Vienna, probably not preserved, whereas that of *C. paniculatus* L. is from India, Malabar. Ekman was the first to discover that the name *I. digitata* L., long used for the above species, actually applies to a rare endemic Haitian species.

SCROPHULARIACEAE

Mazus pumilus (Burm. f.) Steenis in Nova Guinea N. Sect. 9:31, 1958. *Lobelia pumila* Burma. f. Fl. Ind. 186, t. 60, f. 3, 1768. *Lindernia japonica* Thunb. Fl. 253, 1784. *Mazus rugosus* Lour. Fl. Cochinch. 385, 1790. *Mazus japonicus* (Thunb.) O. Kuntze, Rev. Gen. Pl. 462, 1891.

CYPERACEAE

Fimbristylis ovata (Burm. f.) Kern in Blumea 15:126, 1967. *Carex ovata* Burm. f. Fl. Ind. 194, 1768. *Cyperus monostachyos* Linn. Mant. 2:180, 1771. *Fimbristylis monostachyos* (L.) Hassk. Pl. Jav. Rar. 61, 1848.

Scirpus roylei (Nees) Duthie, Fl. Upper Gang. Pl. 3:361, 1921. *Isolepis roylei* Nees in Wt. Contrib. 107, 1834. *Scirpus quinquefarius* Ham. ex Boeck. in Linnaea 36:701, 1869-70.

DEPARTMENT OF BOTANY,
SARDAR PATEL UNIVERSITY,
VALLABH VIDYANAGAR,
GUJARAT, INDIA,
February 15, 1968.

G. L. SHAH

28. NOTES ON SOME INTERESTING PLANTS FROM SOUTH INDIA—1

Oryza officinalis Wall. ex Watt subsp. **malampuzhaensis** (Krishnasw. et Chandras.) Tateoka in Bot. Mag. Tokyo 75:422. 1962. *O. malampuzhaensis* Krishnasw. et Chandras. in Madras Agri. Journ. 45:471-472. 1958.

So far this plant has been reported only from the Western Ghats. The present collection on the banks of Gundlakamma River near Gundlabrahmeswaram in Nallamalais, Kurnool Dt., Andhra Pradesh (*Ellis 22158*, 24-10-1964) is a new record for the Eastern Ghats.

Different opinions prevail regarding the status of this taxon since its publication in 1958 (Bor 1960; Sampath 1961 and 1962; Tateoka

1963). Here we are subscribing to the view of Tateoka who treats it as a subspecies of *Oryza officinalis.*

Parthenium hysterophorus Linn. Sp. Pl. 988. 1753.

Seshagiri Rao (1956) reported the occurrence of this exotic plant from the western part of Peninsular India and had indicated its possible occurrence elsewhere in India. Hakoo (1963) reporting its chromosome number indicates its migration from Poona to Jammu 'together with some rooted cuttings of Jasmines'. Maheswari (1966) reports its common occurrence round about Delhi. Recently, Santapau (1967) mentions its collection in Khandala. Now the collections from Pathalaganga on the banks of the Krishna River in Srisailam, Nallamalais, Kurnool Dt., Andhra Pradesh (*Ellis 16839*, 12-7-1963) and Aliyar submergible area, Coimbatore Dt., Madras State (*Ramamurthy 25600*, 9-4-1963) extend its distribution in the Deccan Peninsula both on the Eastern and Western Ghats. It, therefore, appears that this exotic plant is fast spreading in India.

Liparis prazeri King et Pantl. in Journ. Asiatic Soc. Bengal 2, 66: 582. 1897. *L. flavo-viridis* Blatt. & McC. in Journ. Bombay nat. Hist. Soc. 35:260. 1931.

This plant is not reported in any of the earlier Indian Floras. Recently, Santapau & Kapadia (1965) in their book on Orchids describe this plant in detail and give its distribution from North Kanara in India. The present collection from Kerala-Mysore border in Sultan's Battery and Chedaleth Ranges of South Wynaad Forest Division, Kozhikode Dt., Kerala State (*Elllis 20421*, 15-8-1964) further exotic plant is fast spreading in India.

Botanical Survey of India,
Coimbatore-2,
February 2, 1968.

J. L. ELLIS
M. S. SWAMINATHAN

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29. A NOTE ON THE INFLORESCENCE OF *HYPHAENE INDICA* BECC.

(*With a plate*)

During studies on the ecology of Saurashtra coastal plains, innumerable branching palms (*Hyphaene indica* Becc.) growing wild were located near Una, Delvada, Mandavi, Kodinar and its vicinity. This species is reported to be dioecious; however, Mahabale and Chennaveeriah (1957, p. 186) report the occurrence of monoecious plants with a remark '. . . such instance of hermaphrodite inflorescences are, however, very rare'. While collecting specimens it was noticed that many trees growing near Gogla on the way to Diu Island were monoecious; this consistent occurrence of androgynous inflorescences is a feature of special interest and this led us to an intensive study on *Hyphaene indica*. Two features of interest in this regard are: 1. The androgynous spadix in this species has not been described so far; and 2. there is confusion on the identity of this indigenous species and its closely allied introduced species *H. thebaica* (Linn.) Mart. Since Blatter's (1926) description of *H. indica* is incomplete, a full description of the floral part is presented in this paper.

It was Beccari (1908), who recognised the Indian branching palm (*H. indica*) as distinct from the Egyptian *H. thebaica*. Though Beccari, basing his studies on the specimens from Diu Island, showed that *H. indica* is indigenous to our country, it was Carstensen (1891) who earlier suspected it to be so. The latter's observations in this connection are significant. Previously it was thought that the branching palms at the park in Baroda belonged to *H. thebaica*, but now it has been established that these are *H. indica* (Mahabale and Chennaveeriah, *l.c.*; Rolla 1963). According to Carstensen (p. 271), these plants in Baroda park were '. . . all seedlings from the Doum-palm growing in a wild or at least naturalised state at the Gaekwar's possession near Oomrad in Surat'. He was convinced that these plants in Baroda were quite different from (p. 271) '. . . the wellknown specimens of Doum-palm growing in the Sewree Cemetery, and still more from seedlings in the Victoria Gardens raised from the seed obtained from Aden'. The plants in the Sewree Cemetery and in the Victoria Gardens, Bombay, are *H. thebaica*. Further, he was able to gather information that such branching palms did occur in wild state in Mahuva near Bhavnagar and 'Rawan Tadd' was the common name used by villagers there for this branching palm. Thus, it is clear from his paper that this is a distinct indigenous species. It has been reported that *H. thebaica* was introduced in Bombay by Nimmo in

1828 and again by MacCullough in 1837; according to Haeckel (1883) it was introduced in Ceylon around 1850.

Hyphaene indica Becc. Dichotomously branched palms, dioecious, rarely monoecious, with flabellate, multifid, suborbicular leaves. Spadices up to 100 cm. long, unisexual, androgynous (in monoecious plants), stout; spathes loosely clasping the peduncles, densely woolly tomentose, each terminating on one side in a triangular, acuminate limb; branches of spadix 5-6 each bearing 2-6, digitately arranged branchlets; branchlets up to 25 cm. long, 1·5 cm. in diam., erect to suberect, subligneous, naked up to 5 cm. from base, many-flowered above, the female with few rhomboid tomentose cushion-like structures. Male flowers 5 mm. long, 4 mm. across; perianth segments 6 in 2 whorls of 3 each; the outer 3: each 2 mm. long, oblong, acute to acuminate, imbricate, slightly connate at base; the inner 3: each 2·5 mm. long, broadly ovate, obtuse or rounded, connate at base into a short stalk, rigid, parchment-like, prominently striate-nervose. Stamens 6; anthers sagittate, basifixed; filaments somewhat fleshy, dilated at base; pistillode conical. Female flowers 7-7·5 mm. long, shortly pedicelled; perianth lobes 6 in 2 whorls of 3 each; the outer 3; each 5 mm. long, ovate-orbicular, obtuse or subacute, imbricate; the inner 3: each 6 mm. long, ovate to broadly ovate, rotundate, concave and strongly nerved in its upper half, thick, fleshy, clawed and ciliate along the margins of lower half; staminodes 6, connate into a membraneous ring at the base of ovary. Ovary 4 mm. across, subglobose or obscurely 3-lobed, 3-celled; stigmas 3, sessile. Fruits 6·5-10 cm. long, 2-6 cm. across, obovate, attenuate towards base, subhemispheric to rotundate, with small uneven gibbosities; stalk distinct and clothed with fine brown hairs; epicarp smooth, shining; mesocarp well developed, fibrous; endocarp up to 8 mm. thick, hard, stony, separating from mesocarp in older fruits; endosperm homogeneous, hollow. Seed adnate to the endocarp, erect, ovoid, intruded at base; embryo apical.

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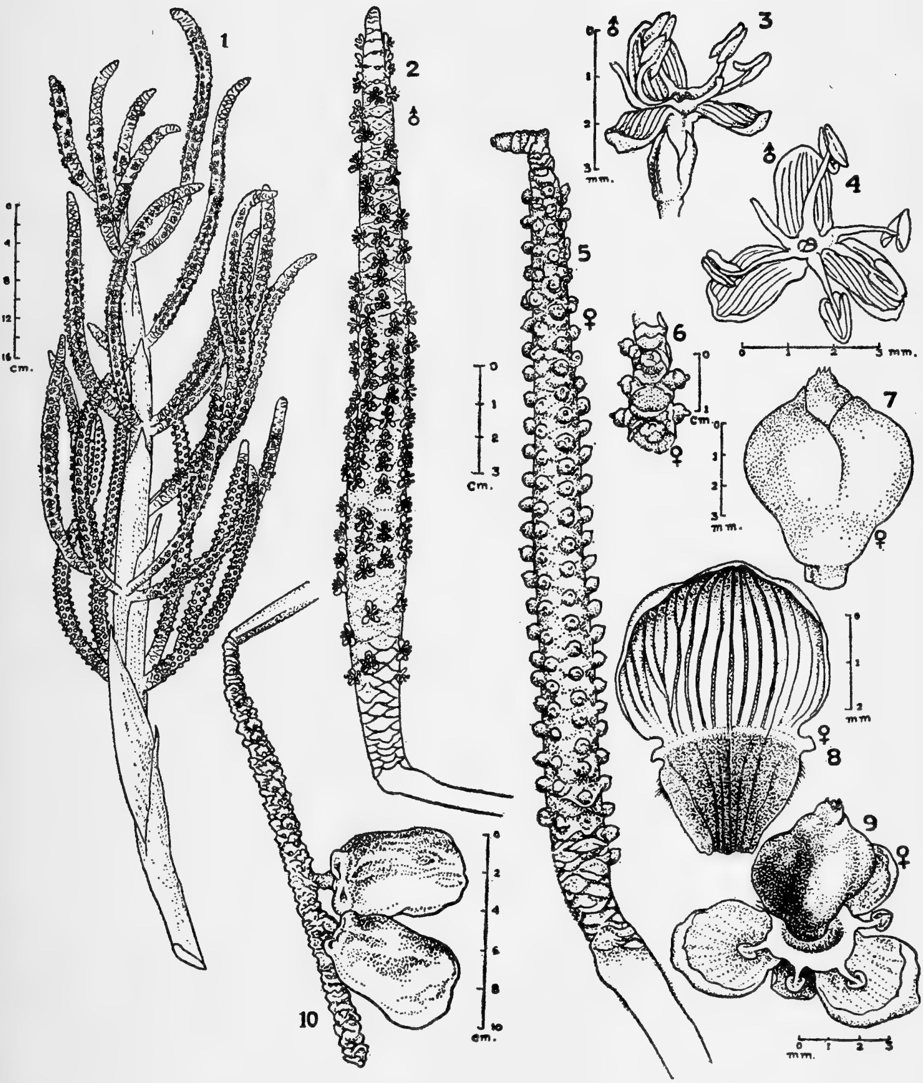
Ecology Section,
Botanical Survey of India,
76-Acharya J. C. Bose Road,
Calcutta-14,
August 26, 1967.

T. ANANDA RAO
B. C. KORLAHALLI



Hyphaene indica Becc.

Figs. 1. Spadix. 2, 5 & 6. Branchlets of spadix. 3 & 4. Male flowers. 7. Female flower. 8. A perianth lobe from an inner whorl of female flowers enlarged (abaxial view). 9 Female flower with floral parts exposed. 10. Branchlet bearing fruits.

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AUGUST 1969

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JOURNAL
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1969 AUGUST Vol. 66 No. 2

The Elephant (*Elephas maximus* Linn.) in Uttar Pradesh, India

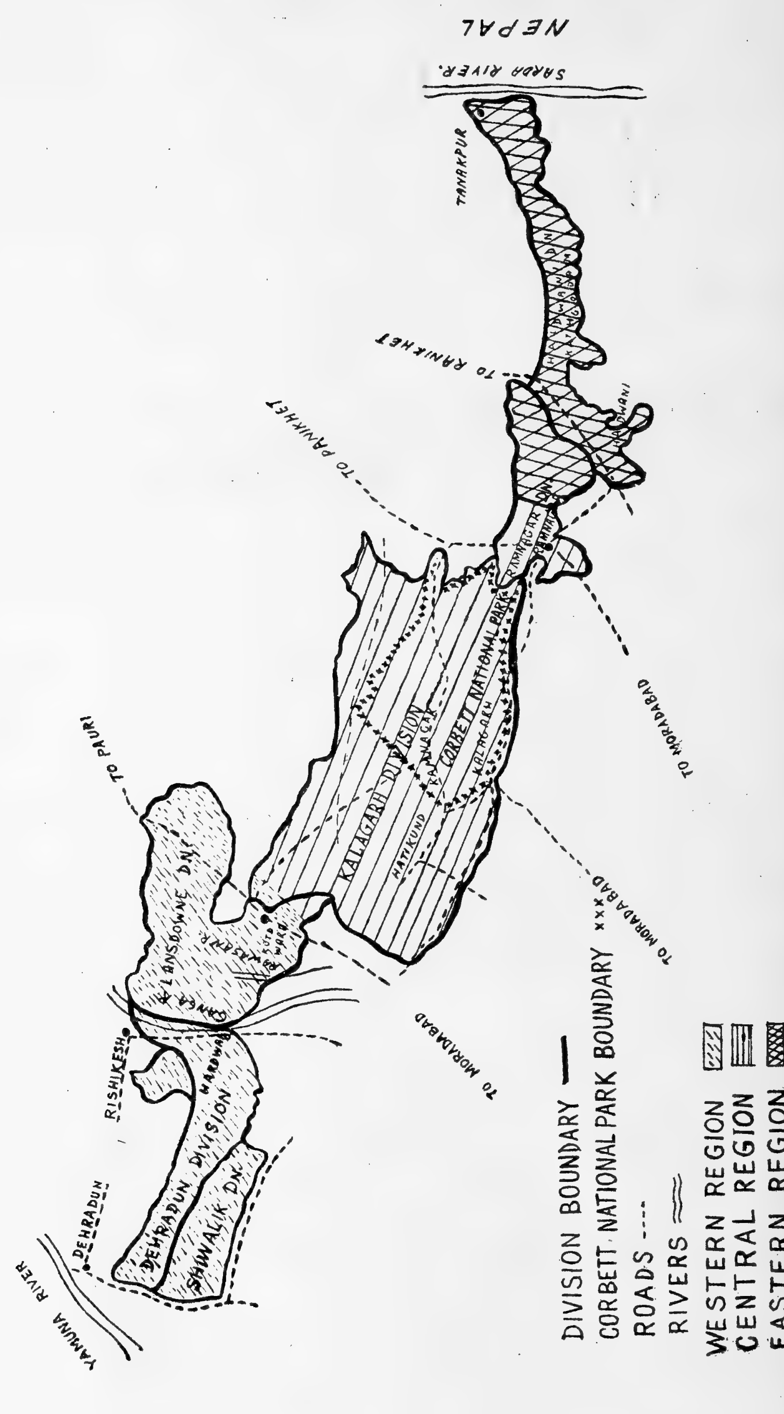
BY

V. B. SINGH, I.F.S.
Chief Wild Life Warden, U.P.

(*With a plate and a map*)

INTRODUCTION

In Uttar Pradesh there has been, for some years, a great deal of agitation against wild elephants which were accused of laying waste agricultural crops and causing human deaths. Newspaper reports describing incidents of damage to crops alleged that the elephant population had grown out of all proportion and called for drastic action in reducing their numbers. It was stated that there were more than 1200 to 1400 elephants in the State and that in Lansdowne Division (Garhwal Dist.) alone there were more than 600 elephants (para 310 of Working Plan of Lansdowne Division 64-65 to 73-74). Some incidents were played up to such an extent that a persistent public demand was created to reduce their numbers. Government had to yield under this powerful pressure, and elephants, protected since 1879 under the Elephant Protection Act 1879, were removed from the protected list in 1963. As many as 27 elephants were killed and 12 were reported to have been wounded. There is no record of the number of unreported wounded. Conservationists alarmed at the eventual threat of extinction of the species strongly represented that the question whether to remove or keep elephants on the protected list should be decided on the basis of a census of the wild population. The argument was accepted by Government and licences to shoot the



Forest Divisions holding elephants in U. P.

animal were withdrawn. This paper reports the census conducted in 1966 and repeated in 1967.

In Uttar Pradesh, elephants are confined to the Tarai and foothills of Dehradun, Siwalik, Lansdowne, Kalagarh, Ramnagar and Haldwani Forest Divisions, in the civil districts of Dehradun, Saharanpur, Garhwal, Bijnor and Nainital. Elephants frequent areas covered with tall forest where the ground is hilly or undulating and where bamboo grows in profusion, or in tall savannah grasslands below the foothills. Their food consists of various kinds of grasses, leaves, stems ; leaves of bamboo, and bark of various species of *Zizyphus, Albizzia, Grewia, Kydia, Ficus, Terminalia, Dalbergia, Emblica, Mallotus* etc. They also relish all agricultural crops.

Since Independence, forests were clear felled and brought under the plough on a large scale. Construction of projects of public utility, for hydel, irrigation, roads, etc. entailed deforestation of large tracts and colonization brought in its wake cultivation right up to the edge of forest. All this resulted in a significant shrinkage in the habitat of wild animals. While approximately 2,50,000 acres constitute at present the habitat of the wild elephant, it is estimated that roughly an equal area was lost in the process of deforestation during the last two decades. The post-war phenomenon of intensive exploitation of forests and the creation of large scale plantations to meet the ever increasing requirement of raw material further aggravated the situation. Together with a further appreciable reduction in the habitat of wild elephants it brought in its wake decrease in food and water supply. Presence of men and machines in every part of the forest brought men and wild animals in direct conflict much to the detriment of the interests of the latter. The disturbances thus caused to wild animals greatly affected their behaviour. Disturbed from their original homes, elephants sought new homes and have taken refuge in areas which were never frequented by them in the past, as in certain areas of west Dehradun Forest Division. The annual migration of elephants from Nepal into the adjoining forest divisions of Pilibhit and Kheri has come to an end owing to the construction of Sarda Sagar and Sarda Head works. Under these circumstances it was but natural that a clash should occur between the interests of man and elephants. With cultivation just abutting the forest, elephants frequently damaged crops and a loss of 5 to 10 human lives through rogue elephants, especially during the working season when there is an exodus of human population to the forest, became a common feature. Eight to ten such rogue elephants causing loss of human lives were reported to be in existence in the State forests.

Census

The first census during the year 1966 was of an exploratory nature. It was repeated again during the year 1967 when the experiences of the previous year were used to advantage. The method followed is described below :

1. The census was carried out simultaneously in the forest divisions of Dehradun, Siwalik, Lansdowne, Kalagarh, Bijnor, Ramnagar, Haldwani and Tarai and Bhaber under the supervision of the Wild Life Wardens in the respective regions and under the overall direction of the Chief Wild Life Warden, Uttar Pradesh. These forest divisions comprise the normal habitat of wild elephants in Uttar Pradesh.

2. Each region was further divided into convenient units and a party of wild life and forest Guards was assigned to each unit under the supervision of an officer of the rank of an Assistant Wild Life Warden or Forester. Three copies of a map of each unit were prepared on a suitable scale for marking the location of herds on the map during each count, and for studying the movement of herds on subsequent counts. For the sake of accuracy three to four counts were made and between two counts sufficient gap was provided to allow reasonable movements of the herds.

3. A particular unit allotted to one party for the first count was given to another party for the second count and to a third party for the third count.

4. The whole operation was planned well in advance and before the actual days of count every effort was made to trace and locate the elephants in each unit with the help of available territorial staff and local labour and other persons.

5. On the actual days of count, the party, on locating the elephants, wrote down the number of herd and the total number of elephants in that herd on the map at the place of its location as accurately as possible. Thus 3/8 meant that the third herd encountered by the party had eight elephants in it.

   In addition to this reference in the map, each party also noted separately, as far as could be ascertained, the numbers of male, female and calves in the herd and other characteristics.

6. In order to ensure independent assessment, the enumeration figures of one party were not given or divulged to another party.

During 1966 and 1967 the elephants were censused on the following dates :

1966 census :		1967 census :	
I Census	15. iii. 66	I Census	15. iv. 67
II ,,	15. vi. 66	II ,,	30. v. 67
III ,,	30. ix. 66	III ,,	15. vi. 67
IV ,,	15. x. 66		

The results of 1966 and 1967 censuses are given in Tables 1 and 2. The exploratory census of 1966 showed that the rainy season is not

TABLE 1

CENSUS OF ELEPHANTS 1966

Counting date	Western region	CNP[1]	Kotdwara region	Dehradun region	Total
1st Count 15.iii.66					
Adults ..	39	30	186	24	279
Calves ..	9	11	33	—	53
Total ..	48	41	219	24	332
2nd Count 15.vi.66					
Adults ..	66	12	214	4	296
Calves ..	20	3	30	—	53
Total ..	86	15	244	4	349
3rd Count 30.ix.66					
Adults ..	58	No herd located as they had gone outside across Dudhia	215	6	279
Calves ..	15		32	—	47
Total ..	73		247	6	326
4th Count 15.x.66					
Adults ..	78	Counting could not be done due to grass	219	3	300
Calves ..	16		40	—	56
Total ..	94		259	3	356

[1] Corbett National Park

suitable for census of wild life owing to restricted visibility and presence of tall grass. There was no difficulty in counting of calves but identification of males, and females was difficult so that the sex ratio fluctuated considerably in the first two counts, and one had to be very careful in

TABLE 2

CENSUS OF ELEPHANTS 1967

Counting date	Western region	CNP	Kotdwara region	Dehradun region	Total
1st Count 15.iv.67					
Male ..	6	9	51	9	75
Female ..	7	16	123	19	165
Calves ..	4	16	42	7	69
Total ..	17	41	216	35	309
2nd Count 30.v.67					
Male ..	22	9	51	30	112
Female ..	40	18	77	36	171
Calves ..	17	11	37	11	76
Total ..	79	38	165	77	359
3rd Count 15.vi.67					
Male ..	16	5	66	14	101
Female ..	27	13	83	27	150
Calves ..	11	9	47	7	74
Total ..	54	27	196	48	325

drawing conclusions from such data. Different investigators used different criteria for sexing wild elephants from a distance, leading to high discrepancy in the sex ratio.

The experience gained in 1966 was used to full advantage by the field staff to avoid mistakes in field counts and for achieving homogeneity in sexing the elephants.

The result of 1967 census are summarised in Table 3.

TABLE 3

Category	I count 15. iv. 67	II count 30. v. 67	III count 15. vi. 67	Total	Average	Percentage
Male ..	75	112	101	288	96	29
Female ..	165	171	150	486	162	49
Calves ..	69	76	74	219	73	22
Total ..	309	359	325	993	331	100

From the above data we may formulate the hypothesis whether all the three counts represent the same population of elephants. The answer to the above hypothesis is in the affirmative as X2 test yields a value of 5·77 on 4 d.f. whereas its tabulated value is 9·488 at 95% confidence limit. We may infer that in round numbers the population of elephants is likely to be composed of 30% males, 50% females and 20% calves.

Having arrived at the likely composition of the elephant population we may attempt to formulate confidence intervals for average elephant population as follows :—

Category	*Pi*	*npi*	*qi*	*npi qi*	$\sqrt{npi\,qi}$	$\sqrt{npi\,qi}$	95% confidence interval
Male	0·3	96	0·7	67	8	16	80 to 112
Female	0·5	162	0·5	81	9	18	144 to 180
Calves	0·2	73	0·8	58	7·5	15	58 to 88

On the basis of evidence furnished by the data the population of elephants in U.P. is not likely to be more than 400 in number.

DISTRIBUTION AND MOVEMENT

From the analysis of census figures certain interesting features of elephant migration were obtained.

Distribution of herds and their regrouping and migrations indicate three distinct population units in the State. The elephant habitat can accordingly be divided into the following three regions :

(1) Western Region, comprising foothill forests of Siwalik, East and West Dehradun Divisions, Lansdowne, and Bijnor Forest Divisions lying on either side of the Ganga River,

(2) Central Region, extending over Kalagarh and Ramnagar Forest Divisions. It includes the Corbett Park area also.
(3) Eastern Region, covering Haldwani and Tarai and Bhaber Divisions.

There is mingling, interchange and subdivision at the fringes where the territories overlap but by and large the core of each population group maintains its separate identity. There is greater interchange between central and eastern zones.

The elephant is a big wanderer and seldom remains confined to a small area. The food habits of elephants are subject to great seasonal variations, depending upon the natural availability of grasses, leaves and barks of various trees they keep moving to favourable areas. Herds migrate regularly between the eastern and western parts of the Western Region fording the Ganga quite regularly. They usually move from the Lansdowne-Bijnor side to the Dehradun forests sometimes in March-April and return to their former haunts prior to the onset of the monsoon in June. However, the exodus is only partial as quite a few herds inhabit these areas more or less permanently. From the census of 1967 the following conclusions are drawn.

Western Region

The Western Region is the main habitat in the State where the bulk of the elephant population stays. An extensive and wide tract along the left bank of the Ganga in Lansdowne Division is the centre from where herds migrate and spread out in the region depending upon availability of food and water. The largest herd located in Rawason River bed in Lansdowne Division consisted of 111 heads. This big herd divided and regrouped itself and various sub-groups dispersed within a radius of 20 miles at various periods of the year. Smaller herds consisting of 10 to 15 heads did not subdivide and regroup themselves. These smaller herds remained as discrete units and were found to confine themselves to areas 5 to 6 miles in radius.

From the census carried out on 15.iv.67 it was learnt that the main habitat of the herds was Koelpura and Jamankhata blocks of East Dehradun Division, in the north-western part of Lansdowne Division and south-eastern part of Bijnor division, with small stray groups or lone elephants scattered here and there. As migration progressed in winter the number of elephants nearly doubled in areas on the right bank of Ganga in Siwalik-Dehradun Divisions through migrants from the Lansdowne-Bijnor area. Some big herds were noticed during May 1967 in the Jhabrawala-Bahera blocks of Dehradun while the herd foraging in Koelpura-Jamankhata appeared to have split into smaller herds dispersed over Suswa-Koelpura and Motichur blocks of East Dehradun Division. Also, the herds in north-west Lansdowne were noted to have

Above : A tusker and two cows ; and, *Below :* part of a herd in the Corbett National Park.

(*Photos : Author*)

moved south-east and the others from south-east to north-west, to form into larger herds. Only a few animals in splinter groups were seen in forests along the western part of Lansdowne Division lying along the Ganga which might have formed portions of bigger herds on the move across the Ganga. During the month of June, possibly on account of availability of food and water in specially favourable localities the concentration of herds was more pronounced. A big herd was spotted in the westernmost extremity (Mohammadpur block) of the west Dehradun Division which seemed to be a result of movement of herds from Jhabrawala (East Dehradun) and Chillawala (Siwalik Division). The large herd seen in Rawason block of Lansdowne Division appeared to have migrated westward on its way to areas lying nearer to the Ganga. Some small herds were also seen on the left bank of the Ganga nearer to the perennial water source. From the census figures for this region, it is apparent that the number of animals in Dehradun-Siwalik Region which stood at a meagre total of 35 in April 1967 increased to 97 in May 1967 while the number in Lansdowne-Bijnor dwindled from 155 in April 1967 to 131 in May 1967, showing thereby large scale exodus of the animals across the Ganga to the western part of the range. The number in the western part again became halved as the summer advanced as quite a few herds moved back across the Ganga to Lansdowne side. Such seasonal migration of elephants in this region lying on either side of the Ganga is a regular feature.

Central Region

In the Central Region comprising Kalagarh and Ramnagar Forest Divisions, more animals occur in Kalagarh. In this Division the total number of animals varies in different months at different places, indicating that there is regular movement of animals in search of food, water and suitable environment. It was, however, noted that there is always a sizeable herd of elephants near Paterpani within the Corbett Park. The herds keep on roaming between Paterpani and Dhikala, moving nearer to Ramganga during the hottest month. There does not appear to be any significant exodus of the species from Kalagarh to Ramnagar Division as the requirement of the animal for its food and water is always locally available. The number of elephants in Ramnagar Division is quite limited and only a few herds were seen moving within the same or adjoining forest blocks, depending upon the availability of food and water. There is some mingling of this herd with the eastern one along a southern route near Lalkua.

Eastern Region

Although the Tarai forests of Tarai and Bhaber Divisions adjoin Haldwani Forest Division and some elephant herds are encountered there from time to time, the latter is in fact the permanent abode of the species. The elephants move out from Haldwani to Tarai and Bhaber forests only in particular seasons and do not stay there permanently, except when they are attracted by cultivated crops in the bordering areas lying along the outer fringes of the forests. The census carried out during April 1967 showed that there were only two small herds, one in the Horai block in the western part and the other in Dogari block in the eastern part of the Haldwani Division. The number of elephants counted during May 1967 showed a steep rise in population which suddenly stepped up from 11 to 67. In the month of June 1967 the total number of animals came down to 48. From the census figures and the location of various noted herds, it could be inferred that a herd seen in Malani block during May 1967 moved westward to Gaula block while another seen in Dogari during April 1967 also moved westward to Hanspur during June, 1967. Similarly two herds seen in Guliapani and Sonabani forests during May 1967 moved out short distances to adjoining blocks. The Haldwani forests are separated from the adjoining Nepal forests by the Sarda River and elephants cross over from one side to the other. This may perhaps explain the reason for the steep rise in their number in Haldwani Division in late summer. It is apparent that large scale exodus of elephants takes place during this part of the year from the adjoining Nepal forests to Haldwani, while the number again goes down during June when the elephants prefer to move back to more favourable areas in Nepal. It is from these herds that some animals move out to adjoining Tarai and Bhaber forests and return to their permanent habitat in Haldwani Division or Nepal.

Conclusions

During years of unusual drought the migration tends to be earlier than normal. Similarly forest fires over large tracts of their normal habitat tends to drive them away to new places.

The composition of herds and the number of elephants in each herd fluctuates widely. While herds comprising of as many as 111 elephants have been seen in Lansdowne Division, smaller herds consisting of 2 to 4 elephants are not uncommon, quite apart from solitary animals which may or may not be ' rogues '. Normally, however, the average herd consists of 10 to 20 animals.

The bigger herds have only been located in particularly congenial localities with abundance of food and water, for example, in parts of Lansdowne Division. During winter and rains there appears to be a tendency to move in bigger groups than during summer and other parts of the year when the food supply dwindles and water becomes scarce.

The number of males in a herd shows wide fluctuation. While in the bigger herds males may be present to the extent of 50 per cent, many herds without a single male have also been seen. On an average males constitute 30 per cent of the herd.

The presence of males in a herd again seems to be influenced by the cycle of sexual activity. During the mating season males have been found in greater numbers in a herd than at other times.

During the course of the census 4 to 5 solitary elephants were recorded. In view of the difficulty in locating all such solitaries it is possible that their number may be much more, say between 8 to 12.

On the basis of the census carried out during 1967 the normal habitat (total area over which they range) of wild elephants in the State, division-wise is as follows :

1.	Dehradun (E) Division	..	46,026 acres
2.	Dehradun (W) Division	..	3,118 ,,
3.	Siwalik Division	..	24,263 ,,
4.	Lansdowne Division	..	45,000 ,,
5.	Kalagarh Division	..	20,000 ,,
6.	Haldwani Division	..	75,000 ,,
7.	Corbett National Park	..	41,548 ,,
	Total	..	2,54,955 ,,
	or say	..	2,55,000 ,,

Assuming the total elephant population to be 400 in the State their incidence turns out to be roughly one elephant per 640 acres or square mile. This incidence is not at all excessive even if allowance is made for reduction in food supply, and other inhibiting factors. As already stated the Elephant Preservation Act was enacted in the year 1879 to afford protection to the species which was reported to be rapidly decreasing in number. Even before the enactment of the above law the capture and destruction of elephants were presumably not of the magnitude it was proclaimed to be. It is almost 90 years since the above enactment was enforced. The present population of 400 over all these years of protection makes it difficult to believe that there has been a population explosion or that the population has increased to an alarming degree. Of course with any forest herbivore the possibility of damage to crops and its control will always be there. This may naturally present greater difficulties with large species like elephants. A few rogues will cause destruction to life and property but such elephants can always be destroyed.

Elephants are a part of the natural wealth of the country and if the era of profit usefulness for man for this outstandingly lovable animal has gone there must be all the more an awakening to the realisation that the preservation of this species is now our responsibility. It is time to take decisive steps to ensure its preservation.

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A Catalogue of the Birds in the Collection of the Bombay Natural History Society—4

Megapodidae, Phasianidae, and Turnicidae

BY

HUMAYUN ABDULALI

[*Continued from Vol.* **65** (3) : 723]

This part covers 946 specimens of 131 species and subspecies including all up to Register No. 23232. It will be noticed that the taxonomical position of several of the game birds is still a little uncertain and I would again request members to try and fill in the gaps in our collection, which would help to remove the uncertainties.

225 **Megapodius freycinet nicobariensis** Blyth (Nicobar Islands, restricted to Nancowry, Central Nicobars, below) Megapode **5** : 437

4 : 2 ♂♂ 2 o ?
2 Nicobar Islands, 2 Nancowry, Central Nicobars.

As already noted (*JBNHS* **64** : 157) the fresh specimens (1966) from Nancowry differ appreciably from those obtained in 1906 from ' Nicobar Islands ', but this may be due to ' foxing ' of the older specimens. In all, the outer web of the primaries is appreciably paler than the inner, and they are probably all of this form.

It may perhaps be worthwhile fixing the type locality of this subspecies to one of the islands of the Central Nicobar group and I hereby restrict it to Nancowry.

226 **Megapodius freycinet abbotti** Oberholser (Little Nicobar Island) nil. **5** : 439

227 **Lerwa lerwa** (Hodgson) (Northern region of Nepal) Snow Partridge **5** : 433

7 : 3 ♀♀ 4 o ?
1 Chini, Kanda 4000′ (Jones's collection=Bashahr, Punjab State ?) ; 1 Gilgit ; 3 *Tibet* ; 1 Garhwal ; 1 North Sikkim.

The bird from North Sikkim No. 21166 appears almost black above

EL **Ammoperdix heyi intermedia** Hartert (Timil, southern Arabia)

6 : 3 ♂♂ 3 ♀♀ *from Muscat, northeast Arabia.*

These specimens were included with *A. griseogularis.* The racial identification is based on the distribution in Peters's CHECKLIST (**2** : 60)

228 **Ammoperdix griseogularis griseogularis** (J. F. Brandt) (Northern and Eastern Iran, *apud* Vaurie, 1965) **5** : 405

26 : 15 ♂♂ (2 by plumage) 11 ♀♀

2 *Duzdap, Seistan* ; 1 *Shush* 5450', *E. Persia* ; 3 *Meshed* (*Mashhad*) *N. Persia* ; 1 *Bog Afghanistan* ; 1 *Kalota Yusuf, near Birjand,* 1 *Kawa Dat* (*Kolwa*), 1 *Zaham, near Panjgur, Makran* ; 4 Quetta, Baluchistan ; 3 Kohat, 1 Miranshah, 1 Sarwakai, N.F.W.P. ; 1 Rawalpindi ; 4 Naing, Larkana Dist., Sind ; 2 no data.

The males are slightly larger than the females :

	♂♂		♀♀	
Wing	123-135	av. 130	119-129	av. 126
Tail	50-61	av. 54	43-55	av. 51

EL **Ammoperdix griseogularis termeuleni** Garudny & Loudon (Arabistan-Khuzistan, southwestern Iran)

9 : 6 ♂♂ (2 by plumage) 3 ♀♀

2 *Shatt-el-Adhain, left bank of River Tigris, Mesopotamia* ; 1 *Niza,* 1 *Filamurz, Khushta, Bikang,* 2 *Bahm-i-Shur, Mishum* ; 2 *Akbarabad* 52° 47'E, 29° 13'N ; 1 *Karung* (?).

The validity of this form has evoked very diverse opinions. Ticehurst (*JBNHS* **31** : 118) stated that the variation was individual and/or seasonal and this is accepted by Vaurie (1965 : 281). The place names on many of the labels have undergone changes, and many of the places now cannot be traced by the name alone. The present specimens however looked so different from the others that I went into the question of the localities more closely and find that they are grouped together in southwestern Persia and in Iraq, east of the Tigris. One label read 'Akbarabad (Baluchistan)', the province having been inserted later in another hand. A closer examination revealed the latitude and longitude in the original hand, which brings it much further west, into Persia.

Marien, 1951 (AM. MUS. NOVIT. 1518) accepts this race but states that the subspecific characters are most easily seen in the females. The three females available have fewer vermiculations on the flanks and can perhaps be separated on this character, but the males are to my eyes more distinctly paler above than *griseogularis.*

The two males from Filamurz and Bahm-i-Shur, both near Mishum, are the palest.

'Karung' cannot be traced. Col. C. H. Stockley who obtained this has collected several other birds at this place on 23rd and 25th August 1921. Another collecting site of his, Tonpi (15 August), cannot be found. Before this, his earlier specimen is from Rawalpindi on 20 July, with no more till October 1923 (Liddar Valley, Kashmir).

Though not marked on the label, several specimens (as in other game birds too) have clipped wings indicating that they have been obtained from trappers. The locality, in such cases, must be treated with circumspection.

229 **Tetraogallus tibetanus tibetanus** Gould (Tibet, type from Ladakh) Tibetan Snow Cock **5** : 429

3 : 1 ♀ 2 o?

1 *Guroo, beyond Phari,* 1 *southeast of Tso Morari,* 1 *Kyamer Valley,* 80 *miles south of Leh in Tibet.*

230 **Tetraogallus tibetanus aquilonifer** R. & A. Meinertzhagen (Interior of Sikkim) **5** : 432

nil.

231 **Tetraogallus tibetanus centralis** Sushkin (Tang-la Pass, Tang-la Range, central Tibet) **5** : 430

nil.

232 **Tetraogallus himalayensis himalayensis** G. R. Gray (Himalayas) Himalayan Snow Cock **5** : 426

3 : 1 ♀ 2 o?

1 Chitral ; 1 above Wangtu, 12,000′, Simla Hills ; 1 Puri Garhwal.

233 **Tetraophasis szechenyii** Madarász (Szechwan or eastern Tibet)

nil.

234 **Alectoris chukar koroviakovi** (Zarudny) (Mountains of Birdjan, eastern Persia, and Persian Baluchistan) Persian Chukor Partridge **5** : 404

18 : 9 ♂♂ 8 ♀♀ 1 o? (2 juv.)

1 *Meshed,* 1 *Naugab,* 1 *Kidri,* 1 *Amirabad near Birjand, E. Persia,* 3 *Duzdap,* 5 *Gudar-i-Chichi, Seistan* ; 1 *near Kaushk,* 10 *miles north of Geh, Persian Baluchistan* ; 2 Mastung, 2 Harboi, 1 Panjgur, Kalat, Baluchistan.

There is considerable variation in the colour of specimens from the same area—two from Duzdap and a third from Kaushk, near Geh in Persian Baluchistan, being greyer and with little or no vinaceous tinge on the upper parts. Except for the four pale birds listed under *werae*, these birds are only very slightly paler than *chukar* and have been separated mainly in accordance with the distribution in Vaurie (1965).

The three adults from Baluchistan, and a ♂ from Razmak, S. Waziristan, show more grey on the head while two juveniles from Mastung are almost as pale as *werae*.

	Wing		Tail
♂♂	151-165 av. 156	(140-156)	82-87 av. 84
♀♀	142-150 av. 147·5		73-83 av. 77·75

Stuart Baker refers to males being heavier than females but does not give separate measurements to indicate that they are appreciably larger

235 **Alectoris chukar pallescens** (Hume) (Karbu, Ladakh) 5 : 404

1 ♀ No. 13645 collected by 'J.S.' in 'Ladak', between Dras and Matayon (?) on 30 September 1875 (Wing 163, tail 88).

This is in pieces and in very poor condition and is marked *pallidus* (the name of the identifier is not mentioned), but that form was described by Hume from further north, Qara Qash River, Sinkiang, than *pallescens* of which the type is from Ladakh. The specimen appears to have a darker vinaceous crown than the others (as in Vaurie 1965 : 273) rather than being paler as indicated in FAUNA **5** : 404 and IND. HANDBOOK **2** : 17/18. In the map accompanying the description in Henderson & Hume's LAHORE TO YARKAND, the type locality appears as 'Kurba' which is not far from Dras.

236 **Alectoris chukar chukar** (J. E. Gray) (Srinagar, Dehra Dun Dist., U.P.) Chukor. 5 : 402

11 : 5 ♂♂ 6 ♀♀

1 Ara (?) ; 1 Razmuk, S. Waziristan, 2 Chitral, N.W.F.P., 1 Bhiji State, 1 Keonthal, Simla Hills ; 1 Lidar Valley, Kashmir ; 2 Mussoorie ; 1 Nepal ; 1 no locality.

	Wing	Tail
♂♂	159-171 av. 167 (♂♀ 146-180)	79-89 av. 85 (♂♀ 78-105)
♀♀	147 (Ara) - 160 av. 154	75-85 av. 81·6

The bird from Ara shows much reddish on the head and upper parts as also the chin and upper breast. It was collected by Lt.-Col. C. H. Stockley on 1-8-1921 and the collection includes two other specimens (of other species) collected by him on 15 and 24 August 1921 at Topi and Karung. None of these 3 places can be found on the maps available but on 20 July 1921 Stockley obtained birds at Chaklala, Rawalpindi, and these places are possibly near-by.

The type locality has suffered many adjustments. Nepal was not accepted with the original description in Gray & Hardwicke's ILLUST. IND. ZOOLOGY **1** (2) : 54 as no exact locality was mentioned, but Nepal, however, appears to have been referred to in an earlier reference quoted by Stuart Baker (FAUNA **8** : 691), i.e. Griffith in Cuvier's ANIMAL KINGDOM, BIRDS, **3** : 54 (ex Gray MS.) August 15th, 1829, which has not been accepted by later authors !

EL **Alectoris graeca werae** (Zarudny & Loudon) (Southwestern Iran, southern Luristan and northern Arabistan)

4 : 1 ♂ 3 ♀♀

2 *Mishun, Persian Gulf* ; 2 *Karagach, Shiraz, S.W. Iran.*

1 ♂ wing 167 ; tail 95.

3 ♀♀ wing 145, 152 ; tail 71, 82, 84.

EL **Alectoris melanocephala** (Rüppell) (Mountains near Jiddah, Arabia)

2 o ? *Jal Hassan, Aden, Arabia.*

These birds collected by a Major Bignell on 28 December 1919 were listed under *A. graeca.*

237 **Francolinus francolinus henrici** Bonaparte (Sind) Black Partridge **5** : 410

28 : 19 ♂♂ (4 juv.) 8 ♀♀ (1 albino) 1 o ?
15 Thar and Parkar, Sind ; 5 Kutch ; 1 Bhavnagar, Gujarat ; 1 Bahawalpur ; 2 Chiniot, Jhang ; 1 Jind, 1 Sirsa, 2 Ambala, Punjab.

Specimen No. 13744 an unsexed juvenile (?) from Bhavnagar, has no rufous patch at the neck and was listed as *pictus.*

238 **Francolinus francolinus asiae** Bonaparte (Asia, restricted to Gurgaon, Punjab) **5** : 408

19 : 14♂♂ 3 ♀♀, 1 pull. 1 chick o ?
1 Chandigarh, 2 Simla, 1 Keonthal, 1 Koti, 1 Patiala 7000′ ; 3 Garhwal, 1 Pilibhit Terai, 1 Fyzabad, 1 Meerut, U.P. ; 6 Nepal ; 1 Baghowni, Bihar.

There is some confusion regarding the distribution of the race *asiae.* Stuart Baker (*JBNHS* **27** : 197, not **28** : 202 as stated in the SYNOPSIS and HANDBOOK) restricted the type locality Asia to Gurgaon, south of Delhi, and this is accepted in both. But Whistler (*Ibis* 1936 : 716) has drawn attention to the fact that birds from this area are *henrici.* Males from Sirsa, Jind, and Ambala (2) in the Punjab are similar to those from Thar and Parkar in eastern Sind. With the material available it is not possible to determine where the two races meet, but I am leaving the Chandigarh bird, a female, with *asiae*, for together with another from Nepal it differs from females from Sind in having darker back and rump with no traces of a buff wash. No white spots are visible round the neck.

Ticehurst (Birds of Sind, *Ibis* 1924 : 512) records *henrici* from Upper and Lower Sind as topotypical, ' decidedly less rufescent above than *asiae* from the Punjab, and somewhat darker than the pale *bogdanovi* from Baluchistan '. He adds : ' Sind birds are not constantly different in colour from *arabistanicus* from Mesopotamia, but are decidedly smaller :

Sind	11 ♂♂	wing 155-162 ;	1 ♀ 146.
Mesopotamia	13 ♂♂	wing 163-178 ;	10 ♀♀ 155-168.'

With the removal of Gurgaon as the type locality of *asiae*, it is necessary that this be reset. However, Whistler in ' On Birds of Jhang District ' (*Ibis* 1922) refers to *asiae* occurring in the riverain area of the Jhelum and Chenab, and I would prefer to examine more material before taking a decision.

The two groups measure :

	Wing	Tail
henrici ♂♂	150-161 av. 155 (148-163 Sind & Baluchistan) (164-175 Persia & Afghanistan)	77-97 av. 85
asiae ♂♂	150-165 av. 156 (145-168)	70-91 av. 83 (77-110)
henrici ♀♀	145-155 av. 151 (149 Sind, 153-160 Persia etc.)	75-89 av. 83
asiae ♀♀	145, 155, 160 (138-167)	74, 83, 84

Single males from Kutch, Bahawalpur and Chiniot, Jhang, have the white markings on the black of the upper back more like streaks than spots, unlike the others, and they appear to extend further down the back. The chestnut collar is also darker, a character said to be of the young male (FAUNA **5** : 409).

Four males from Sind have their black heads very lightly marked with brown, and these also represent a pre-adult plumage.

239 **Francolinus francolinus melanonotus** Hume (Sylhet, Cachar, Garo and Khasi Hills, and Assam Valley) **5** : 411

nil.

239a **Francolinus francolinus** subsp.

9 : (details below).

The eight specimens from Baluchistan fall into three groups, none of which quite agree with *henrici* as they should according to FAUNA, and also, though not specifically stated in the SYNOPSIS. In IND. HANDBOOK (**2** : 21) *henrici* is listed for Las Belas, with a query.

(a) 2 ♂♂ (Nos. 13700/1). Southwest Baluchistan, near Turbat. Wings 150, 160; tails 82, 83.

These birds are paler than *henrici* from Sind and both specimens show a fine line of white feathers extending backwards from the gape, with irregular patches of white at the point of the chin.

(b) 5 : 3 ♂♂ 2 ♀♀ (Nos. 13696-13699, 13707). Chib and Mand, Buleda, Central Makran. Wings ♂♂ 159, 161, 165 ♀♀ 155, 157.

The males differ strikingly from *henrici* in the upper parts being as pale as in *bogdanovi* (q.v.) and marked with black. They are, however, all in very worn plumage. The two females which have been named *bogdanovi* by Ticehurst (?) are quite different from the single female of *bogdanovi* which comes from the type locality. Both are darker above and more heavily marked below, and have black markings around the auricular patch, which characters are absent in *bogdanovi*.

(c) 1 ♂ (No. 13708). Hazarganj, Kalat, North (?) Baluchistan 66° 12′E. (Portion of the label has broken off). Wing 156, tail 82.

This shows a trend towards *bogdanovi* in colour, but the black of the upper breast is unmarked and the area around the neck is also nearer to *henrici*.

From the material available, it is difficult to be very definite, but there appears to be little doubt that in the western portions of its range this bird has broken up into several subspecies, as would be expected of a ground-bound species, in which each population would be well isolated from the others, each one of them being restricted to areas near relatively scarce patches of water.

(d) Sp. No. 20643 ♂, wing 153. Collected by L. H. Saville, no locality given.

The upper parts are dark and more ' golden ' than in any of the others.

EL **Francolinus francolinus arabistanicus** Zarudny & Härms (Sagrossian and Mesopotamian region of Persia)

4 : 2 ♂♂ 2 ♀♀
1 *some miles south of Kut*, 1 *Quahat Sulah, Tigris*, 2 *Amara, Mesopotamia*.

Though Stuart Baker (*JBNHS* **27** : 200) includes both *arabistanicus* and *bogdanovi* under *henrici* both here (p. 201) and in the FAUNA, he refers to birds from Persia and Afghanistan (wings 164-175) as being larger than those from Sind and Baluchistan (148-163). The present specimens are also larger than those listed under *henrici* (wings ♂♂ 167, 178 ; ♀♀ 160, 161) and the males, in addition to a dark neck band, differ from all the others (except a paler *bogdanovi* from the Seistan Delta) in having the upper breast marked with white spots. The white of the cheek patch has fine dark spots scattered over it. Except for the differences mentioned, both sexes are not unlike *henrici* from Sind and the Punjab.

EL **Francolinus francolinus bogdanovi** Zarudny (Seistan and Baluchistan, restricted to Seistan below)

2 : 1 ♂ 1 ♀ *Deh-Jotegh, Helmand River, Seistan Delta*, 1000′.
Wing ♂ 155, ♀ 161 ; tail 80, 87.

Both these specimens are strikingly different from all the others, being much paler on the upper parts. The male has the black of the upper breast largely spotted with white, and in both birds the tail and tail coverts are strongly washed with buff. The ring of white spots on the nape, and the chestnut collar round the neck are indistinct in both specimens.

In view of the remarks under 239a above, the type locality is restricted to Seistan.

240 **Francolinus pictus pallidus** (J. E. Gray) (Udaipur) Painted Partridge 5 : 414

241 **Francolinus pictus pictus** (Jardine & Selby) (Bangalore) Painted Partridge 5 : 412

31 : 12 ♂♂ 15 ♀♀ 4 o ? (3 juveniles).
1 Mt. Abu ; 1 Saugor, 1 Ratlam, 1 Mandu, Dhar State ; 2 Kaira, 2 Dohad, 1 Galkund, Surat Dangs ; 1 Andheri, Salsette, 6 Kalyan, 6 Thana, 2 Panvel,

2 Bombay Market, 2 Wadgaon, Poona ; 1 Gundalur, Sirsi, N. Kanara ; 1 Supkar, Balaghat, M.P. ; 1 Fyzabad, U.P.

There is much variation in the patterns both above and below in both sexes, and with the material available it is not possible to separate the two races.

242 **Francolinus pictus watsoni** Legge (Wellemade, Ceylon) Painted Partridge

nil.

243 **Francolinus pintadeanus phayrei** (Blyth) (Arrakan) Burmese Francolin **5** : 415

6 : 4 ♂♂ 2 ♀♀ (1 by plumage).

1 Manipur, Assam ; 1 *Kalewa, Upper Burma* ; 1 *Gokteik, Hsipaw,* 2 *North Shan States* ; 1 *Maymyo, Mandalay.*

	Wing	Tail
♂♂	149, 150, 155(2) (132-151 av. 144·6)	71, 74, 77, 79 (60-70)
♀♀	138 (137-146)	70

244 **Francolinus pondicerianus mecranensis** Zarudny & Härms (Valley of Rud-i-Sarbas River, Persian Baluchistan) Grey Partridge **5** : 422

7 : 4 ♂♂ 2 ♀♀ 1 o ?

1 *Muscat,* 1 *Pahra,* 17 *miles east of Bambar, Persian Baluchistan* ; 1 Dokop, 1 Pasn 1 Rodkhan, Makran, 1 Pirandar, 1 Wad, Kalat, Baluchistan.

These birds can be distinguished from the others by their greyer upper parts. The chin is white in two specimens and creamish in the others.

Two females (Nos. 13776 and 13777) from Khipro, Thar and Parkar District, Sind, both collected by N. B. Kinnear on 15 December 1910, are similar to *mecranensis* (one more than the other) but both have a rufous supercilium as in *interpositus* and are left with them. They are also redder above than *mecranensis.*

245 **Francolinus pondicerianus interpositus** Hartert (Oudh) Grey Partridge **5** : 421

34 : 16 ♂♂ 15 ♀♀ 3 o ? (1 juvenile, 4 albinoid).

1 Tonpi, N.W.F.P. (?) ; 1 Fort Munro, 1 Lahore ; 1 Barun, 2 Khipro, Thar and Parkar District, Sind ; 4 Delhi ; 1 Deesa, Palanpur, 1 Bhachu, 4 Dhori on edge of Bunni, 1 Kutch, 1 Wankaner, 1 Kharaghoda, 1 Dalkhania, 1 Gir, Amreli, 1 Vaghipur, Mehsana, 2 Mahuda Road, Kaira, 1 Golana, Cambay ; 2 Kymore, Jubbulpore, 1 Pachmari, 2 Saronj, Tonk ; 2 Fatehpur, 1 Ganges Canal, Meerut, 1 Dela Ramnagar, Kumaon, U.P.

The four specimens representing various degrees of albinism come from N.W.F.P., Punjab, Kutch, and Kathiawar. No. 13779 (Kutch) has only pure white primaries and underparts, while the others are almost entirely white with various degrees of dark barring visible both above and below. The specimen from Kharaghoda, Kathiawar, has one foot missing. Six specimens (1 ♂ 4 ♀♀ 1 o ?) : 1 Tonpi (? Stockley), 1 Fatehpur and 1 Dela Ramnagar, Kumaon, U.P., 1 Delhi, 1 Nadiad, and 1 Pachmari, have slightly rufous chins.

246 **Francolinus pondicerianus pondicerianus** (Gmelin) (Pondicherry) Grey Partridge **5** : 419

21 : 9 ♂♂ 9 ♀♀ 3 o ? (1 juvenile).
4 Belgamdagha, Trimbak Road, Nasik ; 1 Naigaum, Poona, 1 Yewat, Dhond ; 1 Hawsbhavi, South Dharwar; 1 Vijayanagar, Bellary; 1 Chikmagalur, Mysore, 3 Odugathur, N. Arcot; 1 Kolatur, 2 Tirthamalai, Salem; 1 near Panagudi, Tinnevelly, 3 Nellore ; 2 S. Andamans.

In the SYNOPSIS, Poona is accepted as the southern limit of *interpositus*, but a bird shot a few miles from Nasik and another from Naigaum, 20 miles west of Poona, have rufous chins and appear nearer to *pondicerianus*. Another from Nasik has a pale chin, while reference has been made under the last form to slightly rufous chins in northern birds. There is a fair amount of variation in the shades of plumage, some of which may be due to age. Old skins show a redder brown than fresh ones.

In all races the male is slightly larger than the female, which does not ordinarily have a spur on its leg.

The single specimen from Chikmagalur, Mysore, is curiously sooty all over, while the male from South Dharwar has the largest wing, 155 mm., the next largest, both 151, being from Bellary and Chikmagalur.

247 **Francolinus gularis** (Temminck) (Vicinity of Calcutta) Swamp Partridge, or Kyah **5** : 417

3 : 1 ♀ 2 o ?
1 Sarda River, Pilibhit, U.P. ; 1 Dibrugarh, Assam ; 1 no data.
Wing 163 ♀, 167, 176 (162-186) ; tail 90, 90, 89 (101-127).

In the SYNOPSIS and the HANDBOOK the type locality has been changed from Cachar (FAUNA) to the vicinity of Calcutta.

EL **Perdix perdix** subsp.

3 o ?
2 *Zinjan, Kaziru-Tabriz, Persia* ; 1 no data.

248 **Perdix hodgsoniae caraganae** R. & A. Meinertzhagen (Shushal, 15,000 feet, eastern Ladakh) Tibetan Partridge **5** : 425

2 o ? : 1 Hanle, Rupshu, 1 Ladakh.
Wing 156, 157 (♂♂ 155-165, ♀♀ *c*. 150-155).
Tail 74, 78 (♂♂ 86-91).

Both are in very worn plumage.

249 **Perdix hodgsoniae hodgsoniae** (Hodgson) (Tsang, Tibet) **5** : 423

3 : 1 ♂ 1 ♀ Kangmar (Tibet ?) ; 1 o ? Bhutan.
♂ Wing—, tail 77 ; ♀ 156, 76.

Two specimens were collected by Capt. R. S. Kennedy at Kangmar, 13,700′, on 25 January 1909. In the register this place is said to be in Tibet, but on the maps available I can only trace one Kangmar, which is in Ladakh, west of Shushal, the type locality of *caraganae*.

Both are generally darker above and have darker and broader neck bands than the two listed as *caraganae*. The latter also show prominent black patches on the breast which are not noticeable in these two specimens. The coloured plate accompanying the original description (*Jour. Asiat. Soc. Bengal* 1856, p. 165) shows a bird much more brightly coloured and with a much darker and broader collar.

The single bird from Bhutan (No. 22963), which is a poor specimen, is generally darker and duller than all the others.

A fragmentary but fresh specimen from Ladakh, which is not worth registering, shows the blue-grey effect which is referred to by Stuart Baker but is not visible in any of the others.

250 **Coturnix coturnix coturnix** (Linnaeus) (Restricted to Sweden) Grey Quail **5** : 372

36 : 15 ♂♂ 12 ♀♀ 9 o ? (1 albinoid, Sind).
2 *Daur, Tigris,* 1 *Sulaimanyeh, Iraq* ; 1 *Shiraz, Iran* ; 3 Quetta, 2 Chitral, 2 Sind, 1 Bahawalpur, 1 Patiala ; 1 Mt. Abu ; 1 Bhuj, Kutch, 1 Kaira, 1 Golana, 1 Rajpipla, 1 Dhari ; 1 Manmad (?), 11 Thana & Bombay, 1 Panvel, 1 Ratnagiri ; 1 Rajputtee, Saran, Bihar ; 2 Imphal, Assam.

The birds show differences in colour both above and below and this is presumably due to fading and foxing.

251 **Coturnix coturnix japonica** Temminck & Schlegel (Japan) **5** : 374

6 : 2 ♂♂ 1 ♀ 3 o ?
1 Dibrugarh, Assam ; 3 *Upper Burma* ; 2 *Peking, China.*

Except for a female from Peking (109) the wings, 98-102 av. 99·4, are smaller than in the Indian birds, ♂ 104-112 av. 106·7 ; ♀ 106-114 av. 110. Neither of the two males show any black on the chin, and the barring on the primaries in the pair from Peking is less distinct than in the nominate race. No bristly feathers are apparent in any specimen nor is there any other character by which they can be separated, and this identification may be incorrect.

252 **Coturnix coromandelica** (Gmelin) (Coromandel Coast) Black-breasted or Rain Quail **5** : 375

25 : 14 ♂♂ 10 ♀♀ 1 o ?
3 Simla Hills, 3000′ ; 2 Bajana, 2 Dakor, Kaira, Gujerat ; 1 Manmad (?), 8 Nasik, 5 Thana & Bombay, 1 Ratnagiri ; 1 Dharwar ; 2 Calcutta Market.

Two of the females were listed under *Coturnix coturnix*, and a female of that species included with this.

The wings measure :

9 ♂♂ 89-95 av. 92 (IH 90-96)
7 ♀♀ 91-98 av. 92·5 (IH 90-97)

253 **Coturnix chinensis chinensis** (Linnaeus) (Nanking, China) Blue-breasted Quail **5** : 369

9 : 6 ♂♂ (4 by plumage) 2 ♀♀ 1 o ?
1 Balaghat, M.P. ; 1 Rajputtee, Saran, Bihar ; 4 Manipur, Assam ; 3 *Thayetmyo, Burma.*

254 **Coturnix chinensis trinkutensis** (Richmond) (Trinkut Is., Central Nicobars) **5** : 371

nil.

255 **Perdicula asiatica asiatica** (Latham) (Mahratta Region, India, restricted to Poona by Whistler, *JBNHS* **38** : 685) Jungle Bush Quail **5** : 377

49 : 18 ♂♂ 20 ♀♀ 11 o ? 24 adults : 8 ♂♂ 16 ♀♀.
4 juveniles 3 ♂♂ 1 ♀ with traces of bars on underparts.
18 streaked juveniles 8 ♂♂ 4 ♀♀ 5 o ? (no rufous chin).
3 downy chicks (Khandala).
1 Pandwa, Surat Dangs, 1 Babulnaghat, Surat ; 1 Dediapada, Rajpipla, Gujerat ; 2 Borivli, 3 Andheri, 2 Bombay ; 1 Karjat, 1 Panvel, Kolaba ; 14 Thana, 11 Malangad, Kalyan ; 2 Konkan, 4 Khandala ; 4 Poona, 2 Panchgani.

The adult females have a rufous chin and a tinge on the underparts. Females from Panchgani and Poona lack this tinge and the vinaceous underparts are very similar to the rufous of the chin and the birds appear different from those from Khandala and the Konkan. The specimen from Poona bears the same date as 3 males which include birds with clipped wings, indicating that they were obtained from trappers and are not necessarily from around Poona. If Poona specimens resemble those from Panchgani, the populations at Khandala, in the Bombay Konkan, and as far north as Rajpipla, will probably need separation.

Two juveniles showing traces of barring on the breast are marked females (see under *P. argoondah meinertzhageni*).

256 **Perdicula asiatica punjaubi** Whistler (Ambala, Punjab)

16 : 9 ♂♂ 7 ♀♀ (1 juv. ♂ 1 ch. Khandesh, 1 ch. Simla Hills).
1 Jagadhri, 3 Baghat State, 1 Simla Hills, Punjab ; 1 Kuna, 1 Narwar Fort, Gwalior State ; 2 Bina, C.P., 1 Khandesh ; 2 Nadiad, 1 Danta, E. of Palanpur ; 3 no data.

The two from Gwalior were listed under *P. a. asiatica* by Whistler *JBNHS* **41** : 479 (1940) with the remark that they were 'not quite typical'.

257 **Perdicula asiatica vidali** Whistler & Kinnear (Kelsi, South Konkan)

1 ♂ (fragmentary) Ratnagiri, S. Konkan.

This specimen is very reddish and probably of this race.

258 **Perdicula asiatica ceylonensis** Whistler & Kinnear (Cocoawatte, Ceylon)

nil.

258a **Perdicula asiatica vellorei** Abdulali & Reuben (Vellore)

2 : 1 ♂ (Type) 1 ♀

1 Odugathur, 1 Asamanpeth, near Vellore, North Arcot.

This race is omitted in IND. HANDBOOK but not synonymised with any accepted form.

258b **Perdicula asiatica** subsp.

11 : 7 ♂♂ 4 ♀♀ (3 by plumage) (1 juvenile ♂).

3 Belgaum, 2 Vijayanagar, Bellary, 3 Shimoga, 1 Seshachalam Hills, S. Cuddapah, 1 Palkonda Hills, 1 Kanyakumari.

As already indicated when describing *vellorei* (*JBNHS* **61** : 690), in the absence of specimens of *vidali* and *ceylonensis* these birds from southern India cannot be fitted into any of the accepted forms, and it is possible that after the plumages and variations are better understood most of them will be found to grade into one or other of the races recognised.

259 **Perdicula argoondah meinertzhageni** Whistler (Nasirabad, Rajputana)

24 : 13 ♂♂ 10 ♀♀ 1 juv. o ?

1 Jalor, Jodhpur ; 3 Abu Road, 2 Chitor, Udaipur, 1 Bardwas, Gwalior ; 4 Deesa, 1 Radhanpur, 2 Nadiad ; 1 Fatehpur, 5 Cawnpore Market ; 4 Calcutta Market.

Both sexes are separable from those from further south (except from Kutch) by their paler upper-parts. Only one (No. 13554, Nadiad, Gujerat) of the 13 males shows the finely speckled unicolorous upperparts accepted as the adult plumage for both sexes in the nominate *argoondah*, the others being barred above, most prominently on the mantle. Whistler (1940, *JBNHS* **41** : 481) describes the juvenile female plumage (Nasirabad) as having a barred head, vinous-buff chin, and barred underparts which last feature he says presents a superficial resemblance to the adult male. Unsexed specimen No. 13553 (Mt. Abu from whence an adult ♂ was obtained on the same day) has growing quills and cannot be described as a chick, but the head is brown with broad pale supercilia as in *asiatica*. The underparts show no traces of barring. Specimens of all races with barred underparts, not unlike adult males, are marked females. One of them (No. 20321) is half-grown, and there can be no doubt that some, if not all, females pass through a plumage similar to that of the adult male[1].

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[1] A note on the immature plumage from Whistler's MSS. is included in IND. HANDBOOK **2** : 49.

A better understanding of the sequence of plumages in both this species and *asiatica* would perhaps permit the description of several additional races of these relatively restricted species.

260 **Perdicula argoondah argoondah** (Sykes) (Dukhun) Rock Bush Quail **5** : 379

21 : 8 ♂♂ 13 ♀♀

1 Sironj, Tonk ; 1 Choral, Indore ; 1 Mata-no-Madh, 2 Chadwa, Kutch ; 1 Dharni, Berar ; 4 Nasik, 4 Manmad (?, captives), 3 Yewat, thirty miles from Poona on Sholapur Road, 1 Poona.

None of the specimens show the barring on the mantle and upper parts referred to in the last race. A half-fledged female (? Manmad) has the underparts strongly barred with black though the chin is perhaps unmarked. Of the 3 specimens from Kutch, 2 females (No. 13557 and 22916) are barred on the underparts. The Kutch birds do not show the same paleness as *meinertzhageni* and are for the moment left with the nominate race. The females and juvenile (?) males show a tinge of redness which is perhaps a trend of *salimalii* from the south. Two males from Nasik are roughly blotched with black on the upper-parts as in *asiatica*.

261 **Perdicula argoondah salimalii** Whistler (Marikanive, Mysore)

4 : 3 ♂♂ 1 ♀

2 Vijayanagar, Bellary ; 1 (Paratype) Marikanive, Mysore ; 1 Wynaad, Travancore.

One juvenile is barred above, as in *meinertzhageni*, but does not show a reddish tinge to the same extent as the adults.

Two of these as well as a pair of *Perdicula asiatica* subsp. were obtained by G. C. Shortridge in July 1912 at Vijayanagar, which is the only place whence specimens of both *asiatica* and *argoondah* are available. They are, however, marked two days apart and may well be from different facies.

262 **Perdicula erythrorhyncha erythrorhyncha** (Sykes) (Valley of Karley, Dukhun) Painted Bush Quail **5** : 381

7 : 4 ♂♂ 2 ♀♀ 1 juv. ♀

2 Ketti, 6700′, Nilgiris ; 1 Shembaganur, 1 Kodaikanal, Palnis ; 2 Peermade, 1 Thekkady, Periyar, Kerala.

In the SYNOPSIS, the type locality is changed to ‘ Karli, North Konkan ’, which is repeated in IND. HANDBOOK **2** : 51. While the change in spelling may be correct, I think the place is above the Ghats in the Deccan and not in the Konkan.

No specimen from near the type locality is available, but the 2 males from Peermade, Kerala, are darker above than all the others. The upper breast shows a tinge of the colour of the upper-parts. The juvenile female shows a remarkable resemblance to the similar stage in *Perdicula asiatica asiatica*, the upper parts being almost indistinguishable and the lower showing similar pale-coloured shaft streaks.

263 **Perdicula erythrorhyncha blewitti** (Hume) (Raipur, M.P.) **5** : 382

2 ♂♂ Lamasinghi, 2500′, Vizagapatam District, A.P.

The two males have been marked *blewitti* by Dr. Sálim Ali, but they are darker below than the others and not greyer as stated in the original description. The material available does not show any differences in size of bills, tarsi, or wings from those from the south.

264 **Perdicula manipurensis inglisi** (Ogilvie-Grant) (Goalpara, Assam) Manipur Bush Quail **5** : 384

4 : 2 ♂♂ 2 ♀♀ Mornai Tea Estate, Goalpara District, Assam.

The specimens on an examination of which this was described in 1909 were from the Mornai Tea Estate, and the present specimens collected by Inglis and Primrose in 1906 and 1907 are topotypes, if not paratypes.

Wing 2 ♂♂ 80, 81 2 ♀♀ 78, 83

265 **Perdicula manipurensis manipurensis** Hume (Bases of hills of southeastern portion of the Manipur plain) **5** : 383

1 ♂ (by plumage) Imphal, Manipur.

The single specimen is slightly darker on its upper parts than the specimens of *inglisi*.

266 **Arborophila torqueola millardi** (Baker) (Koteghur, Simla) Common Hill Partridge **5** : 388

12 : 5 ♂♂ 6 ♀♀ (1 by plumage) 1 chick.

2 Chamba, 4 Simla, 4 Koti State, Punjab ; 1 Mussoorie, 1 Khati, Kumaon, U.P.

	Wing	Tail
5 ♂♂	150, 156, 157(3) (150-161)	54, 60, 61, 62, 63
6 ♀♀	140, 145(5) (144-150)	56, 58, 59(2), 61

267 **Arborophila torqueola torqueola** (Valenciennes) (Bengal) **5** : 386

1 ♂ Katmandu, Central Nepal.

Wing 146, tips broken (148-161) ; tail 61 (76-83).

If this specimen represents the typical race, it is intermediate between *millardi* and *batemani*.

268 **Arborophila torqueola interstincta** Ripley (Mt. Zephu, 93 miles east of Kohima, eastern Naga Hills, Assam)

nil.

Vaurie (1965, p. 294) includes this with the nominate form.

269 **Arborophila torqueola batemani** (Ogilvie-Grant) (Tiddim, near Fort White, Chin Hills) **5** : 389

3 : 2 ♂♂ 1 ♀ [*Bamboo Camp, Chin Hills, Burma.*]

The upper parts of the males are more clearly marked with black cross bars than in any of the others. None of the three show the rufous edging to the third and inner primaries, which is quite distinct in *millardi*. The female is also more closely marked and darker on the upper tail coverts.

Wing	♂♂ 149, 150	♀ 145 (♂♀ 144-154)
Tail	♂♂ 59, 60	♀ 58

270 **Arborophila rufogularis rufogularis** (Blyth) (Darjeeling) Rufous-throated Hill Partridge **5** : 390

5 : 1 ♂ 3 ♀♀ 1 o?

1 Bhimtal, Kumaon ; 2 Sikkim ; 1 Lebong, Darjeeling ; 1 Aka Hills, north of Darrang, Assam.

Wing	Tail
♂ 143 (Stevens* : 9 ♂♂ 138-149 av. 143·6)	
♀♀ 135, 136, 140 (131-142)	50, 50, 51 (♂♀ 50-56)
(Stevens* : 3 ♀♀ 133-142 av. 135·7)	

* Birds of Sikkim Himalayas, *JBNHS* **30** : 889-890

The easternmost bird from the Aka Hills is dark above and resembles another marked *tickelli* (q.v.) from the South Shan States. There are variations in the plumage but with the small numbers available it is not possible to comment upon the differences. All these specimens have a black line below the rufous throat, which is said by Stuart Baker to be a distinguishing character of this subspecies, while Blanford (FAUNA 4 : 126) stated that it was not always present both in this and in *tickelli*.

271 **Arborophila rufogularis intermedia** (Blyth) (Arrakan) **5** : 391

13 : 2 ♂♂ 5 ♀♀ 6 o?

1 Kohima, 2 Manipur, Assam (south of Brahmaputra) ; 2 *Upper Burma*, 1 *near Htawgaw, between Cachin Hills and China* ; 2 *Chin Hills* ; 1 *Mt. Victoria*, 1 *Arrakan Yoma* ; 3 *Mindon Yoma, Thayetmyo, Burma.*

	Wing	Tail
♂♂	139, 145 (138-148)	54, 55 (52-60)
♀♀	135-148 av. 141 (134-143)	47-58 av. 51

The three from Mindon Yoma, Thayetmyo, are paler above than the others.

EL **Arborophila rufogularis tickelli** (Hume) (Malegit, Tenasserim) **5** : 393

1 o? Sp. No. 13588, *South Shan States.*

This specimen which is in poor condition is very similar to No. 13586 from the Aka Hills, north of Darrang, and, in so far as is visible, a black line exists below the chestnut collar. As it is marked *tickelli*, presumably by W. E. Oates (not E. W. Oates of FAUNA) who presented (?) it, I am for the moment leaving it unchanged.

272 **Arborophila atrogularis** (Blyth) (Assam, Sylhet, and Arrakan) Whitecheeked Hill Partridge **5** : 393

14 : 6 ♂♂ 4 ♀♀ 4 o ?

2 Chang Chang Pani, 1 Shillong, 1 Margherita, 1 Gola Ghat, Assam ; 2 *Pum Sin*, 2 *Gora*, 1 *Man Sura, Chindwin Expedition* ; 1 *Chindwin* ; 2 *Kamaing, Upper Burma*, 1 *Myitkyina District, Burma.*

	Wing	Tail	
6 ♂♂	135-143 av. 140 (135-147)	42-56 av. 59·7	(60-65)
4 ♀♀	135-145 av. 140 (126-130)	46-60 av. 51·7	

Some differences in plumage appear between specimens from different areas but the condition and age of the specimens do not permit any remarks.

273 **Arborophila mandellii** Hume (Bhutan Duars) Redbreasted Hill Partridge **5** : 395

nil.

EL **Arborophila brunneopectus brunneopectus** (Blyth) (Tenasserim) **5** : 396

3 : 1 ♂ 1 ♀ 1 o ?

1 *Ruby Mines, Burma* ; 2 *near Hotspring, West Siam.*

274 **Bambusicola fytchii hopkinsoni** Godwin-Austen (Khasia Hills) Bamboo Partridge **5** : 366

4 : 3 ♀♀ 1 o ?

1 Kangpokpi, 1 Dinapur, Assam ; 1 Haka, 1 *Fort White, Chin Hills, Burma.*

3 ♀♀ wing 138, 147, 148 (♂♀ 141-156) ; tail 94, 104, 104 (♂♀ 85-112).

EL **Bambusicola fytchii fytchii** Anderson (Ponsa, Yunnan) **5** : 365

3 : 2 ♂♂ 1 ♀.

2 *Sadan, Myitkyina* ; 1 *Taungri* (*Shan States* ?)

These birds can be separated from *hopkinsoni* by the brown head, which shows up the rufous collar, and by the absence of freckling on the back and rump.

	♂♂	♀
Wing	146, 155	145 (♂♀ 136-152)
Tail	107	99 (♂♀ 85-112)

EL **Tropicoperdix chloropus** Tickell (Tenasserim) Tickell's Green-legged Hill Partridge **5** : 397

2 o ? 1 *Kamaing*, 1 *Chindwin, Upper Burma.*

EL **Rollulus roulroul** (Scop.) (Malacca) Green Wood Quail **5** : 368

6 : 3 ♂♂ 3 ♀♀

4 *Bankochon, Victoria Point, S. Tenasserim* ; 1 *Tenasserim* ; 1 *South Burma.*

	Wing	Tail
♂♂	144, 147, 147 (131-146)	56, 57, 58 (56-63)
♀♀	137, 138, 143 (137-142)	54, 57, 60

275 **Galloperdix spadicea spadicea** (Gmelin) (Ootacamund, Nilgiris) Red Spurfowl **5** : 358

33 : 18 ♂♂ 13 ♀♀ 2 o? (chicks).

(*a*) 2 Langdia, Satpura Hills; 1 Songadh, Navsari, 1 Waghai, Surat Dangs; 2 Suriamal, 2 Thana; 1 Borivli, Salsette; 2 Bhimashankar, 2 Khandala; 1 Panvel, 1 Pen; 3 Mahableshwar; 1 Chikalda (dark underparts), 1 Raipur, Melghat.

(*b*) 1 Shimoga District; 1 Castle Rock, 1 Karwar, North Kanara; 1 Gudalur, Nilgiris; 1 Shembaganur, 1 Perumalmalai, Palnis; 1 Kurumbapatti, Salem; 3 Bastar, 1 Sironcha, Chanda; 1 Jubbulpore; 1 Daspalla, Orissa.

These specimens are divided into two groups: (*a*) birds with pale edges to the feathers (? *caurina* of Blanford), and (*b*) without these edges. The subspecific names used for this and the next two races are as currently accepted, but there is some confusion regarding type localities &c. The matter is rather complicated, and I hope at some later time to deal with it at length.

276 **Galloperdix spadicea caurina** Blanford (Mt. Abu in southern Rajputana) **5** : 361

2 : 1 ♂ 1 ♀ Hathidara, Palanpur, N. Gujerat.

The Palanpur birds were treated as intermediate between *caurina* and the nominate race by Sálim Ali (*JBNHS* **52** : 40 and IH **2** : 69) and listed with the latter. They agree completely with the specimens from Mt. Abu borrowed from the British Museum, while those from the Satpuras are intermediate. Their wings (including the Mt. Abu specimens from the British Museum) are also slightly larger, ♂♂ 162-174 av. 165 (cf. 151-165 av. 157·5); ♀ 158 (140-153 av. 143).

277. **Galloperdix spadicea stewarti** Baker (Aneichardi, Travancore) **5** : 360

1 ♀ Parambikulam, Cochin.

278 **Galloperdix lunulata** (Valenciennes) (Bengale) Painted Spurfowl **5** : 362

19: 11 ♂♂ 8 ♀♀ (some by plumage).

2 Bharatpur, Rajasthan; 1 Chanderi, 1 Narwar Fort, Gwalior; 2 Pachmari, 2 Chandrapur, Bilaspur; 3 Chanda; 1 Hungund, Bijapur; 1 Travancore, 2 Koduru, S. Cuddapah, 1 Tirthamalai, Salem, 2 Odugathur, N. Arcot; 1 Secunderabad, A.P.

The variations in the plumage of this species do not yet appear to be properly understood. Northern birds are larger than those from the south, and where both sexes are available from the same area the females measure slightly smaller.

Males from Bharatpur and Gwalior showed darker buff underparts than those from further south, while the females also fall into two different groups : (a) with sooty underparts, and (b) with underparts largely tinged with buff darkening to a light chestnut. Inquiry at the British Museum

(N.H.) resulted in their very kindly sending in 14 specimens from scattered areas. Though those specimens show the same differences it is not possible to express any definite opinion.

If the darker underparts in the male indicate an adult plumage, it is linked with a black chin spotted with white preceded by a phase with the chin whitish marked with black. The females with dark underparts with a very slight tinge of rufous all have double spurs on their legs while the others, which are paler, have none, one or two indicating that the paler buff chestnut-tinted underparts are an immature character. The latter also have their central tail feathers faintly barred. The specimens received from the British Museum include a female from Raipur with an almost pure chestnut breast, which is no doubt the specimen mentioned by Stuart Baker (*JBNHS* **27** : 14) for this character. There is another specimen with the same data (both come from Hume's collection and bear consecutive numbers), which shows much less chestnut and is not unlike the sooty brown phase referred to earlier.

	Wing		Tail	
(*a*) 5 ♂♂ with dark buff underparts and black chin. Bharatpur (1), Gwalior (2), Bilaspur (1), Nandur (1).	157-164	av. 160	111-124	av. 115
(*b*) 4 ♂♂ with dark buff underparts and white chin. Senoi (1), Jubbulpore (1), Raipur (1), Secunderabad (1).	155-162	av. 158	99-124	av. 108
(*c*) 5 ♂♂ paler buff below, white chin. Chanda 80° 15′ E., 19° 50′ N. (2), Coonoor (1), Tirthamalai, Salem (1), Bijapur (1).	149-155	av. 152	99-108	av. 105

(Eastern Ghats. *JBNHS* **38** : 683—Wing 4 ♂♂ 148-154; FAUNA—♂ ♀ 144-161).

Two males from Koduru, S. Cuddapah (Wings 152 and 143) dated 17 and 18 September 1929 are both dark buff below, but with the larger bird having a black chin (group *a*) against a whitish one in the other (group *b*). Another from Madras (Wing 145) is similar to the latter.

Two females from Koduru, also show the two types mentioned above, but neither has spurs.

279 **Galloperdix bicalcarata** (J. R. Forster) (Ceylon) Ceylon Spurfowl **5** : 363

nil.

280 **Ophrysia superciliosa** (J. E. Gray) (Mussoorie) Mountain Quail **5** : 356

nil.

281 **Ithaginis cruentus cruentus** (Hardwicke) (Mountains of Nepal) Blood Pheasant **5** : 352

nil.

282 **Ithaginis cruentus affinis** Beebe (British Sikkim)

3 ♂♂ Gangtok, Sikkim. Wing 209, 214, 215 ; tail 144, 149, 162.

All three have black foreheads, green along centre of wing coverts, and very little (in one only) red on the breast.

283 **Ithaginis cruentus tibetanus** (Baker) [Sela (Tela in FAUNA) Range, 13,000 ft. above Tawang, on eastern Bhutan-Tibet border] **5** : 355

5 : 2 ♂♂ 3 ♀♀

2 Champithang, Tibet, 11,000′, 1 ♂ Bhutan (died in captivity at Gangtok, Sikkim), 2 Bhutan.

The pair from Champithang, Tibet, are fragmentary and without heads, and are placed in this group because the male shows green on the wing coverts (*contra* brown in *kuseri* from eastern Tibet). The single male from Bhutan differs from the birds from Gangtok in having its crest feathers disintegrated, a little red on the forehead, more red over the eye, and a trace on the breast, and a paler green on the breast and wing coverts. This specimen has no spurs and shows a distinct ear-tuft streaked with white behind the eye. The two females are larger and have their underparts more rufous, less brown, than those under *marionae*. All the males (4) marked *affinis*/*tibetanus* have whitish ends to their tails :

	Wing	Tail
2 ♂♂	203, 208	137, missing
2 ♀♀	190, 191	133, 134

284 **Ithaginis cruentus kuseri** Beebe (north-western Yunnan=Tzeku, 25°05′ N. by 98°51′ E., Vaurie, 1965) **5** : 354

According to the SYNOPSIS (p. 84) this form should occur in the Mishmi Hills in Assam, but the single male from that area appears to agree more closely with the description of *marionae* (q.v.)

284a **Ithaginis cruentus marionae** Mayr (Neytmaw Pass, Burma-Yunnan Border)

8 : 6 ♂♂ 2 ♀♀

1 Akulin, 1 Tsu River, Mishmi Hills, Assam ; 3 *Hpinaw*, 3 *Htawgaw, Upper Burma between Kachin Hills and China.*

The males have a lot more red on the breast than in the single *tibetanus*, and are also distinguished from neighbouring races by the black ear-coverts and red supercilium and forehead (except in No. 13396). Specimen 13396 from Htawgaw differs from another from the same area in having a black forehead, an almost black supercilium, and streaked ear-coverts. The red feathers of the chin are also tipped with cream, presenting a spotted appearance absent in the others. It possibly represents an intermediate plumage.

The birds from the Mishmi Hills appear to agree with the north Burma birds named *marionae* by Smythies (BIRDS OF BURMA, 1953, p. 444) rather than *kuseri* as per SYNOPSIS.

	Wing	Tail
6 ♂♂	190-200 av. 195	140-158 av. 149·6
2 ♀♀	173, 175	125, 129

Mayr, when describing this race (*Ibis* 1941 p. 510) referred to their wings being 190-200 against 200-208 in *kuseri*.

285 **Tragopan melanocephalus** (J. E. Gray) (Almora, U.P.) Western Tragopan **5** : 345

5 : 3 ♂♂ (1 ad*., 2 subad.) 1 ♀ 1 o ?
1 Kashmir* ; 1 Kitha, 1 Simla Hills, 1 N.W. Himalayas ; 1 no locality.

The subadult males from Kitha, 8000′, and Simla Hills, 10,000′, are both referred to as in 'N.W. Himalayas' and are presumably from the Simla Hills. They both have a touch of rufous on the upper breast, white streaks on the breast, and unmarked backs, but the one from Kitha (wing 261, tail 207) has darker underparts than the other (wing 240, tail 159). In fact all five specimens have differently coloured underparts and a much larger series would be necessary to permit any remarks.

	Wing	Tail
3 ♂♂	277 ad., 261, 240 (257-290)	240 ad., 207, 159 (221-247)
1 ♀	250 (225-250)	191

286 **Tragopan satyra** (Linnaeus) (Bengal) Crimson or Satyr Tragopan **5** : 343

9 ♂♂ (4 by plumage, 1 juv.)
1 *Tibet* ; 3 Nepal (died in captivity) ; 1 Dakuri, Kumaon, U.P. ; 2 Chimbu Valley, 1 Sikkim ; 1 died in captivity.

	Wing	Tail
6 ♂♂	250-277 av. 263 (245-285)	222-252 av. 231 (232-300)

The original type locality of Bengal was held unlikely and changed to Nepal by Peters. Biswas, *JBNHS* **57** : 306 (not p. 360 as in IND. HANDBOOK **2** : 82), has shown that this was unnecessary as the species is known to occur in Darjeeling District of Bengal.

287 **Tragopan blythii molesworthi** Stuart Baker (Dengan La, 8000′, Tibet) Tibetan Tragopan **5** : 349

nil.

288 **Tragopan blythii blythii** (Jerdon) (Henema, Naga Hills) **5** : 347

3 : 1 ♂ * 2 ♀♀ (1 by plumage).
1 Kohima, Assam ; 1* *K. Peak, Chin Hills*, 1 *Htawgaw, Upper Burma.*

	Wing	Tail
1 ad. ♂	258 (260-265)	200 (180-220)
2 ♀♀	230, 230 (230-245)	150, 165

289 **Tragopan temminckii** (J. E. Gray) (Szechuan) Temminck's Tragopan **5** : 350

11 : 8 ♂♂ (2 by plumage) 3 ♀♀ (2* juv. ♂♂)
2 Tsu River, Mishmi Hills, Assam ; 1 *Panseng Pass*, 1 *Htawgaw*, *Upper Burma* ; 1 *Hpinaw, between Kachin Hills and China* ; 1 *Lagwi Pass*, 8500′, *Burma* ; 1 *Formosa* ; 4* Bombay market.

	Wing	Tail
5 ♂♂	245-275 av. 258·5 (225-263)	217-228 (185-230)
1 ♀	220 (220-230)	143

The female and young Tragopans have been more difficult to identify than I had anticipated. The four birds from the Bombay market which are 2 males in subadult plumage and 2 females, all with clipped wings and tails, may not be of this species.

290 **Lophophorus impejanus** (Latham) (Sikkim) Impeyan or Monal Pheasant **5** : 335

15 : 10 ♂♂ (1 juvenile) 5 ♀♀
1 Chitral, 1 Kohat, N.W.F.P. ; 1 Simla, 1 Jubbal State, 2 Simla Hills ; 1 Kulu Valley, Punjab ; 1 Phurakia, Almora, 1 Chakrata, 1 Kharak, Garhwal ; 1 Patebhaja, 1 Sattidordu, Nepal ; 1 Sikkim ; 1 died in Victoria Gardens, Bombay ; 1 no locality.

	Wing	Tail
9 ♂♂	287-300 av. 294 (289-320)	215-243 (215-235)
5 ♀♀	258*, 275, 276, 285, 291, (259-287)	195, 200, 205, 210

*Female No. 13353 from the Bombay Zoo has more white than the others on the underparts, a smaller wing (258 mm.), and a bill in which a broad central ridge is distinct from the two sides. This may be a deformity developed in captivity.

None of the males show any of the aberrant plumages which are said to be frequently met with in this species.

291 **Lophophorus sclateri** Jerdon (Mishmi Hills) Sclater's Monal Pheasant **5** : 337

5 : 3 ♂♂ 2 ♀♀ (both extralimital)
2 Tsu River, Mishmi Hills, Assam ; 1 *Htawgaw*, 2 *Hpinaw between Kachin Hills and China.*

	Wing	Tail
3 ♂♂	305, 312, 320 (292-325)	195, 202, 205 (194-206)
2 ♀♀	276, 280 (279)	173, 185 (193)

292 **Crossoptilon crossoptilon harmani** Elwes (Eastern Tibet, about 150 miles east of Lhasa) Eared Pheasant **5** : 339

4 : 2 ♂♂ 2 ♀♀
1 Reting, 60 miles north of Lhasa, 2 near Lhasa, 1 Taga-la, (Tsangpo Valley ?) 13,500′, Tibet.

	Wing		Tail
2 ♂♂	281, 297	(291-331)	375, 378 (457-559)
2 ♀♀	265, 270		357, damaged

The females appear to be smaller than the males. The two males have their bellies purer white than the females, in one of which this is almost all grey like the surrounding area.

EL **Phasianus colchicus elegans** Elliot (Province of Szechuan, near its south-western border) Stone's Pheasant **5 : 305**

4 ♂♂ (2 by plumage)

2 *Panwa Pass* 8000′, *Myitkyina Dist.* ; 1 *Burma-Chinese Frontier*, 1 *Salween-Irawaddy Divide, between* 25° 40′ *and* 26° 45′ N.

Wing	Tail
216, 220, 223, 225 (210-229)	400, 419, 450 (391-487)

EL **Phasianus colchicus tarimensis** Pleske (From Kerashar and the Charchen Darya to Lob-Nor)

2 : 1 ♂ 1 ♀ *Karashaki, Kashgar, S.W. Sinkiang, China.*

There is no collar round the neck and the rump is yellowish.

Wing	♂ 248	♀ 220
Tail	♂ 426	♀ 271

EL **Phasianus colchicus semitorquatus** Severtzov (Kiytin, north-east of Kuldja)

1 ♂ *Urunchi, Dzunugaria, Western China.* Wing 260.

The white collar round the neck is broken in front. This and *tarimensis* were trinomially named by some previous worker.

EL **Phasianus colchicus** subsp.

1 ♂ *China.* Wing 245, tail 395.

This bird has a complete white collar round the neck.

293 **Lophura leucomelana hamiltonii** (J. E. Gray) (Simla) White-crested Kalij Pheasant **5 : 320**

26 : 20 ♂♂ (1 by plumage, 3 juv.) 4 ♀♀ *2 chicks (1 ♀ 1 o ?)

1 Koti State, 1 Patiala, 1 Kufri, 6 Simla*, 1 NW. Himalayas ; 4 Himalayas (J. C. Anderson=Simla, *JBNHS* 1 : 16) ; 1 Dakuri, Almora ; 1 Patagupta Kashi, 1 Lohba, Garhwal ; 1 Chakrata, Dehra Dun, 6 Mussoorie ; 1 Takula, Kumaon ; 1 no data (Jones's collection, probably Simla Hills).

The type locality said to be India in the original description of the synonym *albocristata* was restricted to Simla by Stuart Baker. The SYNOPSIS and IND. HANDBOOK give it as Nepal, whence nominate *leucomelana* is also said to have originated. The distribution of the latter in Nepal is not very clearly worked out and it appears preferable to leave *hamiltonii* at Simla, as has been done by Delacour in the Genus *Lophura*, *Ibis* **1949** : 188 et seq., on which paper my present remarks are mainly based.

Female No. 13298 from Chakrata, Dehra Dun, collected in 1915 is very pale all over and differs from all the females including those of other subspecies. Its wing 225 and tail 229 are longer than in the others of this race (wing 200, 208, 221, and tail 180, 195, 205). In the specimens available (as also in *leucomelana*, *melanota*, and *lathami*) only the two central tail feathers are marked.

The measurements of all the races are listed under No. 298 *moffitti* below.

294 **Lophura leucomelana leucomelana** (Latham) (Nepal) Nepal Kalij Pheasant **5** : 322

5 : 4 ♂♂ 1 ♀
2 Chalna-Khel, 2 Hathiban, Nepal ; 1 Bombay Zoo.

The males differ from *hamiltonii* in having a black crest. The male from the Bombay Zoo (origin unknown) has a sootier breast than the others. The female is darker than *hamiltonii* and very similar to *lathami* from Assam. They do not appear to have smaller wings than *hamiltonii*.

295 **Lophura leucomelana melanota** (Hutton) (Darjeeling) Black-backed Kalij Pheasant. **5** : 323

5 : 2 ♂♂ 3 ♀♀
1 near Darjeeling, 1 Gangtok, 1 Kalijhora 500′, 1 Berrick 600′, 1 Peshoke 2600′ ; Sikkim.

The females are consistently darker than the other races, with the white edges to the wing coverts forming distinct bars. The feathers of the underparts also show conspicuous white edges.

296 **Lophura leucomelana lathami** (J. E. Gray) (Sylhet, Assam) Blackbreasted Kalij Pheasant **5** : 324

9 : 4 ♂♂ 5 ♀♀
2 Khasi Hills, 1 Mikir Hills, 1 Golaghat, Sibsagar, 1 Chang Chang Pani, Naga Hills, 2 Manipur, Assam ; 1 *Mansum*, 1 *Kashikaba, from Jade Mines north-west to Chindwin River, Burma.*

The Vernay-Hopwood Chindwin Expedition obtained this bird on both sides of the Chindwin as far south as Kaunghein *c.* 25° 30′ N.

The 5 females, no two of which are from the same area, show differences of colour which, if supported by similar series, may well represent several subspecies ! No. 13313 from Golaghat, Sibsagar, is darkest, both above and below, with the feathers of the back marked with black.

297 **Lophura leucomelana williamsi** (Oates) (Kalewa, on Chindwin River, Upper Burma) 5 : 326

6 : 4 ♂♂ 2 ♀♀

1 *Fort White*, 1 *Dimla*, 2 *Chin Hills*, 1 *Maydo Chg., Taungdwin, Upper Chindwin*, 1 *Yemmin Chg., L. Chindwin*.

The specimen from Maydo Chg., was obtained by Mears (see *JBNHS* **18** : 86) along the northern portion of the road from Sittang to Tammu in Manipur, which is distinctly south of the area for *lathami*. I am unable to express any definite opinion, but cannot help suggesting that this race appears to be nearer to a Silver Pheasant than to a Kalij, and was so termed when described. The two females (Nos. 13321 and 13323) have all the tail feathers marked as against only the central pair marked in the other races. A large number of races of the Kalij and the Silver Pheasants have been described from a relatively restricted area in Burma and the adjacent countries, and many of them have later been shelved as synonyms and/or as hybrids. While I am not in a position to make an exhaustive critical comment, I would note here that the specimens available in Bombay all fit into definite geographical niches and there is no reason to assume that any are hybrids. Remembering that these birds live in very restricted ecological niches, it is possible that small and adjacent areas may carry very distinct populations as in the case of islands. The same places in Burma have been referred to under widely differing names by different authors, and the same term often covers widely isolated areas. I would suggest, therefore, that a careful examination of wild-obtained material of authenticated origin would remove a fair portion of the uncertainty which has now to be vaguely explained.

298 **Lophura leucomelana moffitti** (Hachisuka) (No type locality given)

1 ♂ obtained by K. S. Ranjit Sinh of Wankaner 'near Thimpu—Omdiphadrang—Tashidong Road in Bhutan' (further amplified to Pe Chu Valley, Central Bhutan, *c*. 27° 30′ N., 90°E. in IND. HANDBOOK **2** : 102).

Ripley identified this as *moffitti* and this is endorsed in the HANDBOOK. It differs from *melanota* in having much less white on the breast but certainly cannot be spoken of as 'all black' as *moffitti* has been described. The feathers of the upper breast are well lanceolate but, in addition to the white shaft streaks, the sides of the feathers are also apparently grey leaving a distinct grey patch on the breast.

	Wing	Tail	Bill
		Males	
hamiltonii	215-245 av. 224·5	230-290 av. 252	23-28 av. 25·3
	(216-249)	(228-327)	(23-26)
leucomelana	230, 232, 233	263, 271, 273	27, 30
	(204-233)	(249-305)	
melanota	235, 245	275, 280	27, 30
	(216-241)	(238-312)	(28-32)

lathami	216, 226, 234, 243 (211-241)	195, 250, 255 (210-245)	26, 27(2), 30 (28-32)
williamsi	234, 237, 238(2) (218-254)	235, 257, 268, 280 (218-304)	25, 26, 27, 30 (28-32)
moffitti (?)	245	198	25
		Females	
hamiltonii	200, 208, 221, 225 (203-215)	180, 195, 205, 229	23, 24, 26(2)
leucomelana	210	198	25
melanota	210 (195-223)	200, 219, 220	26, 27, 29
lathami	204-223 av. 216 (203-228)	185-205 av. 196·5 (190-228)	24-27 av. 25·5
williamsi	210, 220 (195-231)	185, 195	25(2)

EL **Lophura leucomelana oatesi** (Ogilvie-Grant) (Arrakan Hills, Prome Division, Lat. 19° N.) Oates's Kalij Pheasant **5** : 329

2 : 1 ♂ *Thayetmyo District*, 1 ♂ *Bassein, Burma.*

Sp. No. 13331 from Arrakan Hills, Thayetmyo District, is from the Oates Collection and has white bars across the rump. No. 13329 from Bassein (further south) is from the accepted range of this race and has been marked *oatesi.* Though the white shaft stripes on the breast are only a little more prominent than in the other, it lacks the bars on the rump and together with the finer vermiculations on the back appears closer to *lineatus*, east of the Irawaddy.

EL **Lophura leucomelana lineatus** (Vigors) (East Pegu Hills) Lineated Kalij Pheasant **5** : 328

1 ♂ *Pegu, Burma.*

EL **Lophura leucomelana crawfordi** (J. E. Gray) (Hot Sanuk, Ko Lak, Western Siam) **5** : 330 (*sharpei*)

2 : 1 ♂ 1 ♀

1 *Pong Kwai, Thangiu,* 1 *west of Bauma, above Lampha* 2500′; *Tenasserim.*

Both these birds were obtained by Col. Stockley in 1920 when he walked into Siam from Tenasserim. The male has wider white streaks on the breast than in *lineatus*, but the female is brown below, marked with white, with no trace of black (Delacour, THE PHEASANTS OF THE WORLD, 1951, p. 138).

EL **Lophura nycthemera rufipes** (Oates) (Ruby Mines, Burma) Ruby Mines Silver Pheasant **5** : 333

7 : 5 ♂♂ (1 first year*) 2 ♀♀

4 *Htawgaw between Kachin Hills and China,* 1 *N. Shan States,* Tonguin, Burma.*

The three adult males from Htawgaw show appreciable differences in the extent of the barring of the upper parts, but together with the fourth from Tonguin can easily be separated from those listed below under *ripponi* in which the barring is very faint.

Wing ♂♂ 274, 280, 282, 285 (246-279) ♀♀ 242, 257 (228-256)
Tail ♂♂ 445, 505, 540, 580 (406-528) ♀♀ 270, 285

EL **Lophura nycthemera ripponi** (Sharpe) (S. Shan States) Rippon's Silver Pheasant **5** : 331

3 ♂♂ [2 Victoria Gardens, Bombay ; 1 no data.]

The subspecific identification is based only on the fact that their backs are faintly marked with black, as against the distinct dark bars in *rufipes*.

They have smaller wings 240, 264, 268 (256-302) and larger tails 460, 662, 671 (458-635) than *rufipes*.

EL **Lophura (ignita) rufa** (Raffles) (Sumatra) Vieillot's Fireback Pheasant **5** : 316

4 : 3 ♂♂ 1 ♀ *Bankochon, Victoria Point, Mergui, S. Tenasserim.*

	Wing	Tail
♂♂	281, 282, 285 (254-297)	221, 256, 258 (228-325)
♀	256 (223-264)	194

EL **Lophura ignita ignita** (Shaw) (Borneo)

1 ♂ (by plumage) Victoria Gardens. Wing 275.

The bird has been identified in accordance with Delacour's THE PHEASANTS OF THE WORLD.

EL **Lophura** sp.

3: 2 ♂♂ 1 ♀

Sp. Nos. 13340, 13341, 13343 were obtained near Htawgaw between Kachin Hills and China ' by F. C. Lowis in cold weather 1913-1914 '.

Two specimens bear the following on larger labels attached to them :

No. 13341 ♂. ' No. 1 shot at about 6000 ft. elevation, down on the lower slopes of the hills.'

No. 13343 ♀. ' No. 2 *Hen*. Very much the same as the English Pheasant. Habitat on the hillsides and in the bracken, preferring more the fairly open jungle to the dense heavy evergreen. *Cock*. Very much the same as the ordinary home pheasant but with the back a pearly grey '. The back refers to the lower back and rump which is barred white as in a Kalij. Except for the white freckling on the central tail feathers, a longer tail, a heavier bill, white shaft stripes to a few feathers on the sides of the breast (in one only*), and longer spurs (22 mm.) and tarsi (92 mm.), these birds appear much closer to a Kalij than to a Silver Pheasant. And is there any evidence of Kalij (*lathami*) occurring in that area ?

*This specimen also shows less white on the rump and lower back, and a trace of scattered freckling on the upper back. These may be differences due to differences in age development. In the female the two central tail feathers are rufous, while the others are all black except the tips which are slightly freckled as in *williamsi*.

		Wing	Tail	Culmen	Tarsus
♂	13340	258	345	30	92
♂	13341	261	357	30	92
♀	13343	226	190	26	77

299 **Gallus gallus murghi** Robinson & Kloss (Chirala, Gaya Dist., Bihar) Red Junglefowl **5** : 295

17 : 7 ♂♂ (1 immature) 9 ♀♀ 1 o ? Chick.

3 Bhagat State, NW. Himalayas ; 1 Chamundi, Daspala, 1 Berbera, Puri, 1 Tigiria, 1 Badrama, Bamra, 1 Orissa ; 4 Hazaria, Patherghatta, 1 Sonaripur, 1 Haripur Estate, Kheri District, 1 Pilibhit, 1 Amangarh Forest R.H., U.P. ; 1 Bankulwa Morang, Nepal.

	♂♂	♀♀
Wing	227-233 (203-244)	182-211 (177-196)
Tarsus	70-81 (70-80)	60-68

300 **Gallus gallus spadiceus** (Bonnaterre) (Malacca) Burmese Junglefowl **5 : 298** (*robinsoni*)

6 : 4 ♂♂ 2 ♀♀

1 Lakhuni, 1 Abor Hills, Assam ; 1 *Mansum, Chindwin*, 1 *Chin Hills*, 2 *Pyangaung, N. Shan States, Burma.*

These birds show no consistent differences from Indian birds in size or colour and have been trinomially named entirely on the distribution as in the SYNOPSIS. Some of the males do not show the golden border nor the black streak along the shafts of the neck feathers as in *murghi*. From the specimens available, it is not possible to comment upon the differences in colour of the ear-lappets (white in *murghi* and red in this form), but there does not appear to be unanimity in this respect among the earlier authors. Colbias (*Cheetal*, April 1967) stated that Indian cocks associated with hens had larger combs than those not accompanied by the hens, and drew attention to comb size stimulation by male hormones. Later (op. cit. Oct. 1967, p. 67) J. Angami wrote that junglefowl shot in summer had larger combs than those in winter and that this was caused by insect bites, all shot in summer having ticks on their combs!

(Specimen No. 22674 obtained by H. S. Cook at Maymyo, W. Burma, marked as a cross between a *Gallus* and a domestic fowl, is not included above).

301 **Gallus sonneratii** Temminck (India, restricted to Eastern Ghats near Madras) Grey Junglefowl. **5** : 298

32 : 22 ♂♂ 10 ♀♀

1 Sadra, Mahikantha, Gujerat ; 1 Langadeja, Satpura District, 2 Kolkaz, 1 Chikalda, 1 Peli, Melghat, Berar ; 2 Mandikheri, Hoshangabad Dist., M.P. ; 6 Pen, 1 Dharamtar Creek, Kolaba ; 1 Castle Rock, 1 Yellapur, 1 Sirsi-Jog, N.

Kanara ; 1 Talewadi, Belgaum, 2 Sorab, 1 Sagar, Mysore ; 1 Makul, Coorg ; 1 Shembaganur, Palnis ; 1 Attikan, Billigirirangans ; 1 Mariankatta, 2 Avalanche, Nilgiris; 2 Thekkady, Periyar Lake, 1 Tenmalai, Travancore; 1 Shirnelly, Cochin.

There appear to be no constant differences of size or colour in this widely distributed species.

	♂♂	♀♀
Wing	209-247 av. 233 (220-254)	193-217 av. 204 (200-215)
Tail	210-382 (330-375)	121-143 av. 124 (about 150-175)
Tarsus	73-84 av. 78 (70-75)	63-71 av. 66.

The female tails are shorter than indicated in the FAUNA[1]. The two smallest, 121 and 122, are from Pen, Kolaba District, while the next, 131, is from the Billigirirangan Hills.

Sp. No. 13234 from Mariankatta, Nilgiris, is a female with well-developed spurs on both its legs.

Sp. No. 13340 (Cochin) is a young (?) cock with a well developed tail and prominent hackles on the wing coverts. The head and neck, however, are covered with sooty black feathers which have fine pale-coloured centres but show no traces of hackles.

302 **Gallus lafayettii** Lesson (Ceylon) Ceylon Junglefowl **5** : 300

2 : 1 ♂ 1 ♀ Ceylon.

♂ Wing 228 (216-241)
♀ Wing 196 (165-183)

The slightly longer wing in the female is confirmed by Whistler in THE AVIFAUNAL SURVEY OF CEYLON, 1943 (?), p. 256.

303 **Pucrasia macrolopha castanea** Gould (Kafiristan) Chestnut-mantled Koklas Pheasant **5** : 313

5 ♂♂ (1 juv.)

1* Kila Drosh, Chitral-Kafiristan, 1* 8000′, 1 Lowrie Pass, 1 10,000′, Behrdan (?), Chitral ; 1 Kashmir.

Nos. 13274* 8000′, Chitral, and 13276* Kila Drosh appear to be more blackish on the breast and underparts, which are almost uniformly maroon in the other two. The bird from Kashmir (No. 13278), which has the tail missing, shows more black than all the others ; this and the maroon-rufous of the upper breast extending on to the nape and upper back make it appear closer to the westernmost *castanea* than to those from Lidar Valley, Kashmir, listed under *biddulphi* (q.v.).

The bird from Kila Drosh was collected by Lt. J. A. S. Roper. The female of *castanea* was described for the first time by V. S. La Personne (*JBNHS* **34** : 1062) on the basis of a bird obtained by Lt. Roper at the same place. This specimen was not registered in the Society's collection and is not now traceable.

Wing 237-252 av. 243 (about 240)
Tail 156, 173, 182, 205 (about 178)

[1] 100-170 in IND. HANDBOOK.

304 **Pucrasia macrolopha biddulphi** Marshall (Kashmir) **5** : 312

3 ♂♂ (1 juv.)
3 Lidar Valley, Kashmir (1 at 11,000′).

Marshall's description in *Ibis* 1879 is reproduced in *Stray Feathers* **8** : 445-449 (1880). The two adults mentioned above are marked *biddulphi* by Sálim Ali, but when compared with the original text several discrepancies appear, some of which are :

Original text	In Lidar specimens
(*a*) Mantle black, some of the feathers edged with stone grey, and some with sandy brown.	(*a*) Mantle greyish with some of the feathers with black streaks in centre. Streaks narrower than in *castanea*, *nipalensis*, and the nominate *macrolopha*.
(*b*) Wing 8·75 inches (222 mm.) cf. 9·75″ (247 mm.) and 8·37″ (240 mm.) in *castanea* and nominate *macrolopha* respectively.	(*b*) The wings measure 246 and 240 mm. which are no shorter than in the others, but they appear to have longer tails than *castanea*, 222 and 245 cf. 156, 173, 182 and 205.
(*c*) Distinguish from nominate *macrolopha* by the very broad black centerings to the feathers of the mantle.	(*c*) the black centres of the grey feathers of the mantle are much finer and sometimes absent.
(*d*) The feathers of the upper tail coverts and rump are said to be grey, each centered buff with a dark brown margin to the buff on each side.	(*d*) One of the two has a few feathers so centered, and the other none. These marks are distinctive.

Hume in a footnote (*Stray Feathers* **8** : 447) refers to *biddulphi* being similar to *castanea* and being found in Western Kashmir. Blanford (**4** : 86) also mentions *biddulphi* as from West Kashmir, and refers to the chestnut of the breast extending round the neck. This is a very conspicuous character which does not occur in nominate *macrolopha* or *nipalensis* ; if Blanford is correct in this respect, the Lidar birds are not *biddulphi*, which name would probably apply to the single specimen from Kashmir, referred to under *castanea* (No. 13278). This would leave the Lidar valley birds either undescribed or covered by a name now not in use and synonymized with some other.

Wing	246, 250	(233-249)
Tail	222, 245	

305 **Pucrasia macrolopha macrolopha** (Lesson) (Almorah Hills, Kumaon) **5** : 310

11 : 7 ♂♂ (1 juv.) 4 ♀♀

2 Himalayas (J. C. Anderson=Simla ?), 3 Koti State, 1 Simla ; 2 Top Tirbu, Mussoorie, 2 Chakrata Hills, 1 Mornauli, Kumaon Hills.

The labels for two specimens read 'Chakrata Hills, N.W.F.P.' and are no doubt in error for N.W.P. which was the term used for U.P. I cannot help fearing that the same error will necessitate the amendment of the accepted distribution of other races and species.

	Wing			Tail		
♂♂	224-243	av. 236	(215-244)	183-247	av. 220	(221-227)
♀♀	206-220	av. 213	(180-218)	147-173	av. 163	(172-195)

Though there are differences in the markings on the upper parts, the adult males differ from the 5 *castanea* in : (1) having a broad stripe of chestnut running down the whole length of the front, with black streaks on grey at the sides, (2) the absence of rufous on the nape and upper back, and (3) a definite rufous tint on the middle tail feathers.

306 **Pucrasia macrolopha nipalensis** Gould (Nepal) **5** : 312

1 ♂ Bombay Zoo, said to be from Nepal. [Wing 226 (208-228)]

The single specimen, in which the tail is damaged, has no distinctive central chestnut stripe on the feathers of the mantle.

EL **Pucrasia macrolopha xanthospila** Gray (China)

2 : 1 ♂ 1 ♀ *Peking Market, China.*

Wing		Tail	
♂ 220	♀ 206	♂ 182	♀ 157

307 **Catreus wallichii** (Hardwicke) (Almorah Hills) Chir Pheasant **5** : 307

6 : 3 ♂♂ 3 ♀♀ (including 1 juv.).

2 Koti State, Simla Hills ; 2 Mussoorie, U.P. ; 2 Himalayas (A. Newnham).

	Wing		Tail	
♂♂	247, 250, 256	(235-269)	440, 441, 535	(388-584)
♀♀	225, 241	(223-245)	230, 355	(317-468)

308 **Syrmaticus humiae humiae** (Hume) (Manipur) Mrs. Hume's Pheasant **5** : 303

7 : 6 ♂♂ (1 by pl.) 1 ♀*

1 Phailenkot, Manipur* ; 1 *Fort White*, 1 *Haka*, 3 *Chin Hills*, 1 *Burma*.

The measurements of the race *burmanicus* are included below.

		Wing		Tail	
humiae	♂♂	206, 209, 220, 222	(206-224)	370, 400, 525, 553	(401-535)
burmanicus	♂♂	205, 225	(215-236)	183, missing	
humiae	♀	204	(198)	194	
burmanicus	♀	199	(195-210)	158	

Specimen No. 13249 in male plumage collected by J. M. Mackenzie at an unspecified place in Burma does not have the feathers of the lower back and rump as clearly bordered with white as in the others, but this may be due to soiling.

EL **Syrmaticus humiae burmanicus** (Oates) (Ruby Mines, Burma) Burmese Barred-back Pheasant 5 : 304

3 : 2 ♂♂ 1 ♀
2 *Ruby Mines, Upper Burma* ; 1 *Taungyi, S. Shan State.*

The measurements are included under No. 308 above.

EL **Chrysolophus amherstiae** (Leadbeater) (Yunnan) Lady Amherst's Pheasant 5 : 314

5 ♂♂ 1 *Htawgaw* 6400′, 1 *Hpinau* 6000′, *Upper Burma*; 1 *Western slopes of Salween-Irrawady Divide* (*between* 25° 40′ *and* 26° 45′ N.) ; 2 no data.

Wing	Tail
213-232 av. 218 (205-233),	980-1065 av. 1024 (863-1143)

309 **Polyplectron bicalcaratum bakeri** Lowe (Bhutan Duars) Peacock-Pheasant 5 : 291

9 : 5 ♂♂ (one by pl.) 4 ♀♀
1 Kalioni, Mikir Hills, 2 Lashan, NW. Territory, Manipur, Assam ; 1 *Sadon*, 1 *Upper Burma* ; 1 *Hai Bwu*, 1 *Gora*, 1 *Dalu*, 1 *Tawmaw*, last four collected by Vernay-Hopwood Chindwin Expedition 1935 Myitkyina ?, Upper Burma.

	Wing	Tail
♂♂	215-222 av. 220 (203-228)	310-362 av. 341 (304-402)
♀♀	193, 195, 202, 204 (177-203)	235, 241, 245, 284

310 **Polyplectron bicalcaratum bicalcaratum** (Linnaeus) (Yunnan) Peacock-Pheasant 5 : 289

3 ♂♂
1 Chang Chang Pani, 1 Naga Hills ; 1 2500′ *West side of Daumas, above Lampha Tenasserim.*

	Wing	Tail
♂♂	211, 212, 215 (203-228)	310, 347 (304-402)

The absence of topotypes and the fact that the specimens of both *bakeri* and the nominate race are all from an intermediate area make it difficult to separate them. One of the two from the Naga Hills has the markings on the upper surface buff (as in the bird from Tenasserim) but the other from Chang Chang Pani has them white as in the more western birds. Delacour (1951) includes birds from the Naga Hills under this subspecies and I am leaving them so. The Tenasserim specimen with almost complete rings of white round the ocelli of the rectrices shows a trend towards *ghigii* Delacour & Jabouille from Annam.

EL **Argusianus argus** (Linnaeus) (Malacca) Argus Pheasant 5 : 286

2 ♀♀ [1* *Bankachon, South Tenasserim* ; 1 Bombay Zoo.]

Wing	Tail
307, 335 (300-330)	266, 295

One of them*, more rufous and with a shorter, brown crest, is presumably immature.

311 **Pavo cristatus** Linnaeus (India) Common Peafowl 5 : 282

8 : 3 ♂♂ 3 ♀♀ 2 o ? (1 chick in down*).
1* Ghoti, Nasik ; 1 Houkan, SW. Dharwar, Mysore ; 1 Shahjehanpur, Oudh; 2 Hazaria, Pattarghatta, Bhagalpur, Bihar ; 2 Bombay Zoo ; 1 no data.

	Wing	Tail (upper tail coverts)
♂♂	458, 466, 483 (444-495)	910, 1177, 1205
♀♀	400, 434 (about 395-425)	300, 305

Specimen No. 13190 (wing 310) is marked ♀ but has chestnut primaries and is probably a juvenile male.

312 **Pavo muticus spicifer** Shaw & Nodder (India) Burmese Peafowl 5 : 284

3 : 1 ♂ 2 ♀♀
1 *Monnyin, Minbu District* ; 1 *Pank Kaung, Prome Dist.* ; 1 Bombay Zoo.

	Wing	Tail
♂	451	398
♀♀	439, 441	400, 407

Though he suggested the possibility of its being an escapee, it may be worthwhile keeping in mind the fact that a male shot in Jalpaiguri Dist., North Bengal, was recorded as of this species by Daniel (1957, *J. Bengal Nat. Hist. Soc.* **29** : 111).

313 **Turnix sylvatica dussumier** (Temminck) (Bengale) Little Button Quail 5 : 450

3 : 1 ♂ 1 ♀ 1 o ?
1 Shindri, Khipro, Sind ; 1 Kalyan, Thana, Bombay ; 1 Kanpur Market.

Wing

♂ 71 (60-71) ♀ 70 (73-75) o ? 73

The collection is remarkably poor in this widely spread and relatively common species. The SYNOPSIS and IND. HANDBOOK use the popular name Little Bustard Quail, which is no doubt in error for Little Button Quail.

EL **Turnix sylvatica lepurana** (A. Smith) (Western Transvaal)

2 : 1 ♂ 1 ♀
1 *Pongeola R., near Candover, N. Zululand* ; 1 *near Pretoria, Transvaal, Africa.*

The female (wing 82) appears twice as large as the male (Wing 72, bill 10).

314 **Turnix tanki tanki** Blyth (Bengal, restricted to northern suburbs of Calcutta by Biswas, *JBNHS* **57** : 518) Button Quail **5** : 454

13 : 4 ♂♂ 8 ♀♀ 1 o?

1 Kalka 2500′, 2 Simla Hills ; 2 Chadwa, Bhuj, Kutch ; 2 Chikalda, Berar ; 1 Balaghat, 1 Bailadila, Bastar, M.P. ; 1 N. Kanara ; 1 Sagar, Mysore; 1 Sankrametta, Vizagapatam, A.P. ; 1 Berbera, Puri, Orissa.

In the FAUNA (1928) and GAME BIRDS (1930) Stuart Baker refers to the different plumages of old, not so old, and young females, and of adult and young males. Seasonal changes, at least in the female, have been referred to, but there appears to be no definite opinion thereon. The series available includes three females which differ from the others in having their heads distinctly barred with black and white followed by broad rufous collars. The upper parts are pale greyish brown, with very faint markings which are much more prominent in all the others. Two of them were certainly breeding (both August : one with an egg in the oviduct, the other with a greatly distended oviduct), while the third is marked August but bears no other details. None of the other females (nearest dates 6th June before and 17th January later) show this plumage, but there are markings which may indicate transition stages between this and other plumages.

The different plumages in the male may also be seasonal (See remarks under *Turnix suscitator taigoor*. Measurements under 315a below).

315 **Turnix tanki blanfordii** Blyth (Burma and Arrakan—type from Thayetmyo) **8** : 453 (*maculatus*)

3 : 2 ♂♂ 1 ♀

1 *Nyannggyo, Prome,* 1 *Kyanin, Henzada, Burma* ; 1 *Peking, China.*
Measurements under 315a.

315a **Turnix tanki albiventris** Hume (Andamans)

3 : 2 ♂♂ 1 ♀

2 Trinkut, 1 Camorta, Nicobars.

In addition to the differences mentioned in my Nicobar paper (*JBNHS* **64** : 158), the female has a noticeably heavier bill than in nominate *tanki*, but this is similar to a ♀ *blanfordii* from Peking.

The wings of the several races measure :

	♂♂	♀♀
T.t. tanki	79, 80, 80, 81 (71-79)	(8) 85-91 av. 88 (79-89)
T.t. blanfordii	87, 91 (92-96)	100 (97·5-105)
T.t. albiventris	79, 82	86

316 **Turnix suscitator plumbipes** (Hodgson) (Nepal) Bustard Quail **5** : 445

2 : 1 ♂ 1 ♀ ?

1 Laittensew, Khasi Hills, 1 Manipur.

The subspecific identification is based on geographical grounds.

317 **Turnix suscitator bengalensis** Blyth (Lower Bengal) **5** : 448 (*isabellinus*)

1 ♂ Calcutta, off 4 eggs.

See note under 318 below.

318 **Turnix suscitator taigoor** (Sykes) (Dukhun) **5** : 447

38 : 19 ♂♂ 19 ♀♀ (some by size and plumage).

2 Kalka, 2500′ Simla Hills ; 2 Ambala, 1 Jhind, Punjab ; 1 Bharatpur ; 1 Kutch, 2 Kaira, 1 Mehsana, 2 Daman, Surat, Gujerat ; 1 Central India ; 12 (9 ♂♂ 3 ♀♀) Bombay, Konkan ; 1 Daulatabad, 1 Nasik, 1 Yewat, 1 Kamshet, Poona ; 1 Rajapur, Ratnagiri ; 2 Hatikeri, North Kanara ; 4 Vijayanagar, Bellary, 1 Dharwar ; 1 Orissa.

The amount of variation in those listed as *taigoor* is in many instances greater than visible in the specimens of *plumbipes* and *bengalensis*, which have been separated here only on geographical grounds according to the SYNOPSIS. It is now generally accepted that the young female first has the male plumage before acquiring the distinctive black patch on the throat and breast. I do not have enough material to confirm or deny Ticehurst's statement (*Ibis* 1939 : 229) that the juvenile female (of *plumbipes* only ?) can be separated from the male by its narrower primaries. As in *tanki*, there is considerable uncertainty regarding the sequence of plumages, but, as also in that species, there is evidence that the female at least acquires a breeding plumage, the main character of which is a black forehead marked with white spots. This is found in females obtained in Kutch (September) and Bombay (October), both of which had oviduct eggs. Two more females (Nos. 13819 and 13820 from Vijayanagar, Bellary) have similar markings and, though there is no reference to the state of their gonads, they were obtained on 20 and 21 July. Among the others only two (Punjab 16th Feb. and Poona 21 March) show traces of such spotting. This suggests a breeding plumage, which may vary seasonally in different parts of the country. The single ♂ from Bharatpur is much paler above than any of the others.

The other phases of plumage also appear to fall into seasonal groups, but the material available is insufficient to permit any conclusions. Once this is understood, there is little doubt that it will be possible to separate additional races. The series from the Bombay area, for instance, is almost certainly different from those from the adjoining Deccan.

EL **Turnix suscitator pallescens** Robinson & Stuart Baker (Thayetmyo) Pegu Bustard Quail **5** : 450

1 ♀ *Henzada District, Burma.*

EL **Turnix suscitator blakistoni** (Swinhoe) (Canton) Chinese Bustard Quail 5 : 448

1 ♂ *Naunpung, Shan States.*

Both this and the last race are named entirely by their place of origin.

319 **Turnix suscitator leggei** Baker (Cocowatta, Ceylon)

nil.

(*to be continued*)

Orchids of Nepal—1

BY

M. L. BANERJI[1] AND B. B. THAPA[2]

(*With three text figures*)

In recent years orchids have attracted much attention from horticulturists and plant lovers in Nepal, and there are quite a few good collections of orchids to be seen in Kathmandu. Even in the interior of the country, particularly in the district headquarters of eastern parts of the country, one often finds some orchids either in pots or hung from the windows, species which are not common in the area. And it is a common sight to find women working in the forests gathering firewood or cutting grass, having a spray of orchids in their hair. To trace the history, knowledge about Nepal orchids began with the collections by Buchanan-Hamilton, and the publication by D. Don's PRODROMUS FLORAE NEPALENSIS, and later N. Wallich's TENTAMENT FLORAE NEPALENSIS. Hooker's FLORA OF BRITISH INDIA consolidated the records of the orchids from Nepal. Later Burkill listed the orchids collected by him on his journey to Nepal (*Rec. Bot. Surv. Ind.* **4**, 59 : 140, 1910) and Parker (*For. Bull. Bot. Ser.* 76, 1931) listed some orchids from Western Nepal that were collected by B. L. Gupta and Lal Dhowj. In FAUNA AND FLORA OF NEPAL HIMALAYAS, Kitamura has worked out the orchid collection of the Japanese expeditions, and in the recently published THE FLORA OF EASTERN HIMALAYA by H. Hara, some Nepal orchids are also given.

The senior author has been collecting orchids in eastern Nepal since 1948 when he began his studies on the flora of that part of the country, but both the authors have been together in Nepal during 1964 to 1967, and have been actively engaged in the study of the orchids of the country. The junior author has spent many years collecting, growing, and studying orchids found in the neighbourhood of Kathmandu, and occasionally from other places of Nepal. The necessity of preparing a comprehensive list of the species found in Nepal was felt, and this work was taken up. This list primarily includes species collected by one or both of us, and has been supplemented by records made by other published works and the unpublished data and information of Dr. G. A. C. Herklott,

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[1] University of Kalyani, Kalyani, W. Bengal.
[2] Horticultural Assistant, Indian Co-operation Mission, Kathmandu.

who was in Kathmandu some years back under the British Aid to Nepal to develop the Godavari Botanic Gardens of the Government of Nepal. As such no herbarium reference is given. Whenever we collected in the neighbourhood of Kathmandu, the plants were brought to the garden for study and observation ; however, when collections were made from the interior of the country, herbarium specimens were made in the conventional manner.

In this part, we deal with the species belonging to the genera *Bulbophyllum*, *Cirrhopetalum*, and *Sunipia*. The plan we will follow for the entire series is : a brief description of the genus is given and for the species, the flower characters and the flowering time is given followed by the altitudinal range of distribution, and localities of our collections as well as those by Burkill and Kitamura. In Parker's and Herklott's lists the localities are not given. For the species which have been collected by us, we have been able to study the colour of the different parts of the flower but it must be admitted that we have not been able to follow the accepted colour nomenclature as none of the standard manuals for colour standards was available to us. As regards the time of flowering, we have been able not only to note it in the field but in many cases, having grown the species for one or two years, have had the opportunity of studying the phenology in a limited way. We express our deep gratitude to Mr. A. D. Schilling, the then Advisor for the Godavari Botanic Gardens, Govt. of Nepal, (under the British Aid Plan) for giving us his own recordings of flowering times of many species for comparison with our observations, and also the list of some orchids collected by Dr. Herklott.

We have also given some line diagrams of some of the representative species of the genera, as it has not been possible to draw all the species that have been collected by us. It is hoped that this series on the orchids of Nepal will meet the needs of the professional botanist, the horticulturist, as well as of the amateur.

Bulbophyllum Thouars

Rhizome usually long and creeping or hanging, somewhat short and bearing a series of pseudobulbs, each of a single joint and one leaf at the tip, very rarely 2-leaved ; pseudobulbs close or distant and varying much in size. Inflorescence of one to many flowers, the scape usually arising at the base of a pseudobulb but sometimes at another node of the rhizome ; flowers in short or long racemes. Flowers very small to fairly large ; sepals almost equal, the laterals longer than the dorsal, lateral sepals joined to the column-foot to form a usually short mentum, often much longer than wide, free or with both edges more or less joined ; petals nearly always much smaller than the sepals, rarely about equal to the sepals ; lip hinged to the column-foot, in most cases mobile, often of complex structure, usually fleshy and more or less tongue-shaped, straight or curved, the sides usually somewhat raised at the base, the whole or part of the lip often papillose or warted or even hairy ; column short, usually with conspicuous arms or wings, which often rise like a pair of slender horns above the small anther, anther 2-chambered, containing 4 pollinia in pairs ; column-foot usually curved forwards beyond its junction with the bases of the sepals forming a pedestal in the flower upon which the lip hinges.

Artificial key to the species of *Bulbophyllum*

A. Lateral sepals not connate ; lip recurved and shorter than the sepals

B. Flowers solitary, rarely 2-3, usually large. Scape sometimes very short ; pedicel long

C. Column truncate : lip stipitate

D. Scape long ; petals 1-nerved, $\frac{1}{2}$ shorter than the sepals.................................*striatum*

DD. Scape short ; petals 3-5 nerved, $\frac{1}{3}$ shorter than the sepals.................................. *affine*

CC. Column with two teeth or spines

D. Flowers greenish or yellow and spotted. Lateral sepals and petals 7-nerved...........*leopardinum*

DD. Flowers reddish brown. Lateral sepals 5-nerved ; petals 3-nerved ; column teeth very short....*wallichii*

BB. Flowers capitate or subumbellate

C. Lip minute, sessille and papillose. Rhizome stout ; leaf 2·5 cm. or more..............*odoratissimum*

CC. Lip shortly stipitate. Rhizome thin and slender ; leaf 2·5 cm. or less...................*caudatum*

BBB. Flowers racemose or spicate

C. Lip with recurved basal auricles. Rhizome stout. Raceme decurved, bracts usually exceeding the flowers, flowers spotted...............*careyanum*

CC. Lip without basal auricle

D. Sepals pubescent. Flowers yellow or greenish-yellow, scented........................*hirtum*

DD. Sepals and petals glabrous

E. Pseudobulbs ovoid or globose. Spike lax; flowers not flattened; lip yellow....*reptans*

EE. Pseudobulbs very small. Spike erect; flowers dorsally flattened..............*cylindraceum*

AA. Lateral sepals connate. Lip rather large, straight and rigid

B. Lateral sepals 3-nerved. Flowers white; lip purple with a ridge...................................*bicolor*

BB. Lateral sepals 5-7 nerved. Flowers greenish; lip purple with solid tip...............................*paleaceum*

Bulbophyllum affine Lindl. Gen. et Spec. Orch. 48, 1830; F.B.I. 5: 756, 1890; King & Pantl. in Ann. Roy. Bot. Gard. Calc. 8: 67, t. 91, 1898; Hara in Fl. Eastern Himal. 426, 1966.

Flowers greenish-yellow, streaked with red; petals ovate-lanceolate, acute, 5-nerved, about a third shorter than the reflexed falcate sepals; lip shortly stipitate, reddish-brown, column yellow. *Flowering* during May and June; widely distributed between 1000-2000 m. Collected from Chandragiri, Sundarijal, Sheopuri, Lamidanda, Goarigaon to Chainpur.

B. bicolor Lindl. Gen. et Spec. Orch. 49, 1830; F.B.I. 5: 770, 1890.

Spike short, flowers crowded, membranous, small, dull white; sepals subequal, linear-lanceolate, acuminate, laterals connate at the bases, whitish with pink nerves, petals ovate or oblong, faintly serrate; lip traversed by a ridge which terminates in a short rigid emarginate point, purple or pinkish. *Flowering* during September and October; widely distributed between 1500 & 1800 m. Collected from Tarebhir (below Sheopuri), Chandragiri, Godavari, and Sundarijal. This species is very much like *B. reptans*.

B. careyanum Spr. Syst. 3: 732, 1836; F.B.I. 5: 760, 1890; King & Pantl. 71, t. 97, 1898; *Pleurothalis purpurea* D. Don, Prodr. Fl. Nep. 33, 1825. (Fig. 1).

Flowers orange-yellow or with greenish shade, more or less spotted with reddish-brown or purple; sepals oblong-ovate, acute, dorsal slightly shorter; petals minute, broadly ovate, aristate, 1-nerved; lip subentire, column spurs long, aristate and forming a broad base, reddish-brown. *Flowering* in October and November; distributed between 900 & 1200 m. Collected from Pokhara, Dhankutta, locality unknown (Herklott).

F.B.I. gives that sometimes the flowers are almost all blue, or purple, but we have not seen such flowers.

B. careyanum var. **ochraceum** Hook. f. in F. B. I. (loc. cit.). Flowers darker or deeper in colour and unspotted. Collected from Tokha, *c.* 1500 m.

B. caudatum Lindl. Gen. et Spec. Orch. 56, 1830 ; F.B.I. 5 : 759, 1890 ; Hara in Fl. Eastern Himal. 426, 1966. *Cirrhopetalum caudatum* King & Pantl. 93, t. 129, 1898.

Flowers small, 8 mm. long, papillose ; sepals lanceolate, caudate, 3-nerved, lateral sepals longer than the dorsal and three times as long as the petals; petals oblong, obtuse, 1-nerved; lip shortly stipitate, spurs slender. This species is recorded on the authority of Hara.

B. cylindraceum Lindl. Gen. et Spec. Orch. 53, 1830 ; F.B.I. 5 : 765, 1890 ; King & Pantl. 70, t. 96, 1898 ; Hara in Fl. Eastern Himal. 426, 1966.

Flowers dorsally flattened, greenish-yellow ; dorsal sepal triangular with sometimes a spirally coiled tip, lateral sepals oblong, obtuse, petals small, oblong, 1-nerved ; lip ovate, greenish-purple. *Flowering* during September and October; collected from Sundarijal area *c.* 1800 m. In F.B.I. the colour of the flower is given as white, pink or deep purple, but our material had flowers which were greenish-yellow.

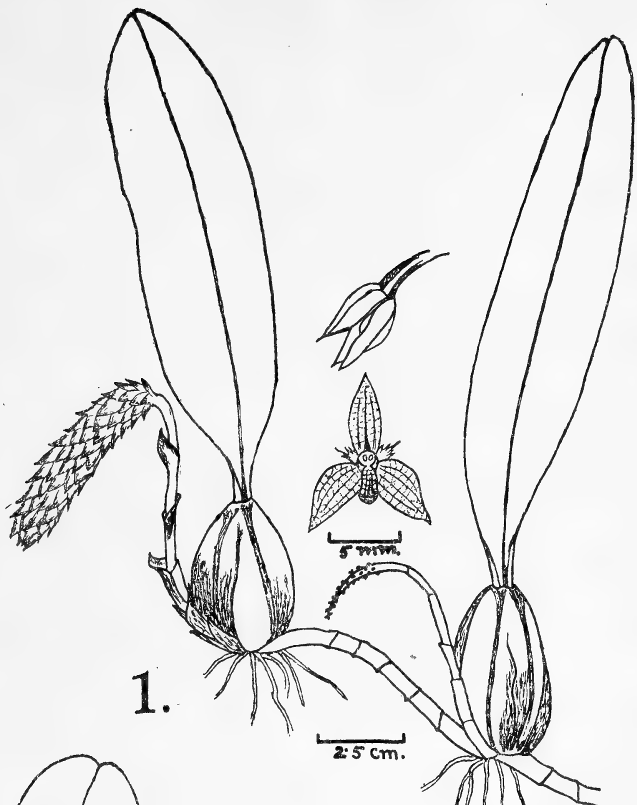
B. hirtum Lindl. Gen. et Spec. Orch. 51, 1830 ; F.B.I. 5 : 762, 1890 ; King & Pantl. 84, t. 117, 1898.

Flowers yellow or greenish-yellow, scented ; dorsal sepal lanceolate, 3-nerved, shorter and narrower, lateral sepals falcately lanceolate, 3-nerved, base broad; petals small, oblong, obtuse, ciliate ; lip subsessile, clawed, linear-oblong, truncate, hispid below. *Flowering* in November and December; distributed at 1500 to 1800 m. Collected from Sheopuri and Sundarijal.

B. leopardinum (Wall.) Lindl. Gen. et Spec. Orch. 48, 1830; F.B.I. 5 : 756, 1890 ; King & Pantl. 67, t. 92, 1889 ; Hara in Fl. Eastern Himal. 427, 1966. *Dendrobium leopardinum* Wall. Tent. Fl. Nep. 39, t. 28, 1826. (Fig. 2).

Flowers subglobose, greenish or yellow, spotted purple ; sepals broadly ovate, 9-nerved; petals broadly ovate, acute, 7-nerved ; lip long stipitate, and with auricles at the base, base yellow, tip purple. *Flowering* during July and August ; distributed at 1500 to 1800 m. Collected from Sundarijal, Sheopuri, Godavari, locality unknown (Herklott).

B. odoratissimum (Sm.) Lindl. Gen. et Spec. Orch. 55, 1830 ; F.B.I. 5 : 758, 1890 ; King & Pantl. 79, t. 109, 1898 ; Hara in Fl. Eastern Himal.



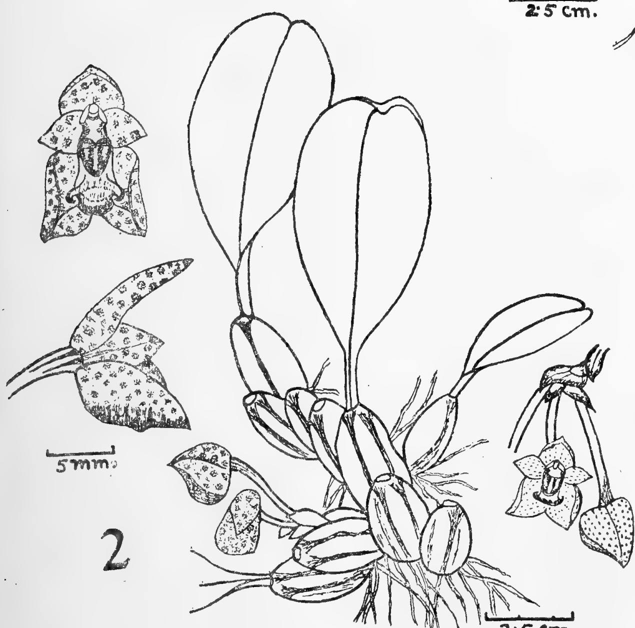


FIG. 1. *Bulbophyllum careyanum* Spr. FIG. 2. *B. leopardinum* (Wall.) Lindl.

427, 1966. *Stelis odoratissima* Smith in Rees Cyclop. 34, 1816. *S. caudata* D. Don, Prodr. Fl. Nep. 32, 1825.

Flowers yellow, sweet-scented ; sepals subequal, lanceolate, caudate. 3-nerved, tips solid, petals minute, 1-nerved, sessile, papillose. *Flowering* during April and May, even upto mid August ; and distributed at 900 to 1500 m. Collected from Yangsabessi-Pokhara area.

B. paleaceum Benth. & Hook. Gen. Pl. 3 : 503, 1883 ; F.B.I. 5 : 769, 1890.

Flowers drooping ; sepals many nerved, laterals wholly connate, greenish, pink nerves ; petals broadly oblong, spreading, sub-serrate, 1-3 nerved, membranous ; lip ovate-lanceolate, purple, entire or slightly wavy, tip solid. *Flowering* during October and November ; widely distributed at 1500 to 1800 m. Collected from Sheopuri, Sundarijal, Chandragiri, and Godavari.

B. reptans Lindl. Gen. et Spec. Orch. 51, 1830 ; F.B.I. 5 : 768, 1890 ; King & Pantl. 77, t. 106, 1898 ; Hara in Fl. Eastern Himal. 427, 1966.

Flowers sessile, spike lax ; sepals subequal, narrowly lanceolate, acute, 3-nerved, yellowish-purple, lateral sepals slightly gibbous ; petals broadly obtuse, 1-3 nerved ; lip stipitate, recurved, yellow, column very small. *Flowering* during September and October, and again in February and March of the following year ; well distributed at 1800 to 2100 m. Collected from Sheopuri and Daman. This species is very much like *B. bicolor.*

B. striatum Reichb. f. in Walp. Ann. 6 : 257, 1861 ; F.B.I. 5 : 755, 1890 ; King & Pantl. 75, t. 102, 1898.

Flowers yellowish-green, striped with purple ; sepals subequal, oblong-lanceolate, 5-nerved, petals ovate-lanceolate, acute, 1-nerved, half the length of the sepals ; lip linear-oblong, obtuse, thin, dull purple. *Flowering* during September and October ; distributed at 1500 to 1800 m. Collected from Sheopuri—above Narayanthan, and Shankhoo.

B. wallichii (Lindl.) Reichb. f. in Walp. Ann. 6 : 259, 1861 ; Hara in Fl. Eastern Himal. 428, 1966. *Cirrhopetalum wallichii* Lindl. in Wall. Pl. Asiat. Rar. 1 : 53, t. 67, 1830 ; F.B.I. 5 : 776, 1890.

Flowers reddish-brown; dorsal sepal oblong, tip rounded, 3-nerved, lateral sepals acuminate, falcately incurved, 5-nerved, 3-4 times longer than the dorsal sepal; petals as long as the dorsal sepal and similar ; lip subacute. *Flowering* in March and April ; distributed at 2100 to 2400 m. Collected from Bagdwar-Sheopuri area, and Godavari. This species very much resembles *Cirrhopetalum hookeri* Duthie, but can be made out by the colour of the flower and the lax inflorescence ; the colour of the flower being yellow with reddish purple nerves.

Cirrhopetalum Lindl.

The genus *Cirrhopetalum* has been considered a section of the genus *Bulbophyllum* by J. J. Smith (*Bull. Jard. Bot. Builtenz.* ser 2, 8 : 19-29, 1912) and by Holttum (REV. FL. MALAYA, I, 1953); according to Pfitzer (PFLANZENF. 2 (6), 1889) and later Fischer, (FL. MADRAS PRES. 1928), *Cirrhopetalum* should be maintained an independent genus. Hooker (FL. BRIT. IND. 5 : 772, 1890) treated *Cirrhopetalum* as a separate genus although he adds 'the two genera might as well be regarded as one'. We follow those who have a preference for treating the genus separate and distinguish the genus as having flowers in whorled umbels, rarely in racemes or solitary. Posterior sepal as concave, much shorter than the lateral ones; petals shorter than posterior sepal; labellum small, tumid, entire and adnate to the foot of the column, and mobile; column short, apex with two tooth-like appendages.

ARTIFICIAL KEY TO THE SPECIES OF *Cirrhopetalum*

A. Flowers umbelled—

B. Dorsal sepal glabrous or nearly so. Petals erose and ciliate. Flowers with a disagreeable smell..........*cornutum*

BB. Dorsal sepal and petals glabrous, quite entire

C. Lateral sepals 3-5 nerved

D. Lateral sepals 3-nerved; petals obliquely ovate ....*hookeri*

DD. Lateral sepals 5-nerved; petals broadly ovate ....*elatum*

CC. Lateral sepals 7-nerved, twice as long as the dorsal sepal

D. Flowering scape shorter than the leaf. Flowers unspotted. Columnar spurs small, teeth-like ....*maculosum*

DD. Flowering scape exceeding the leaf. Flowers spotted. Columnar spurs long....*guttulatum*

AA. Flowers racemose. Lateral sepals many times longer than the dorsal sepal. Lip spotted with red............*refractum*

Cirrhopetalum cornutum Lindl. Bot. Reg. Misc. 75, 1838; F.B.I. 5: 774, 1890.

Flowers with an unpleasant smell; dorsal sepal small, green and blotched with purple-brown, lateral sepals linear-lanceolate, obtuse,

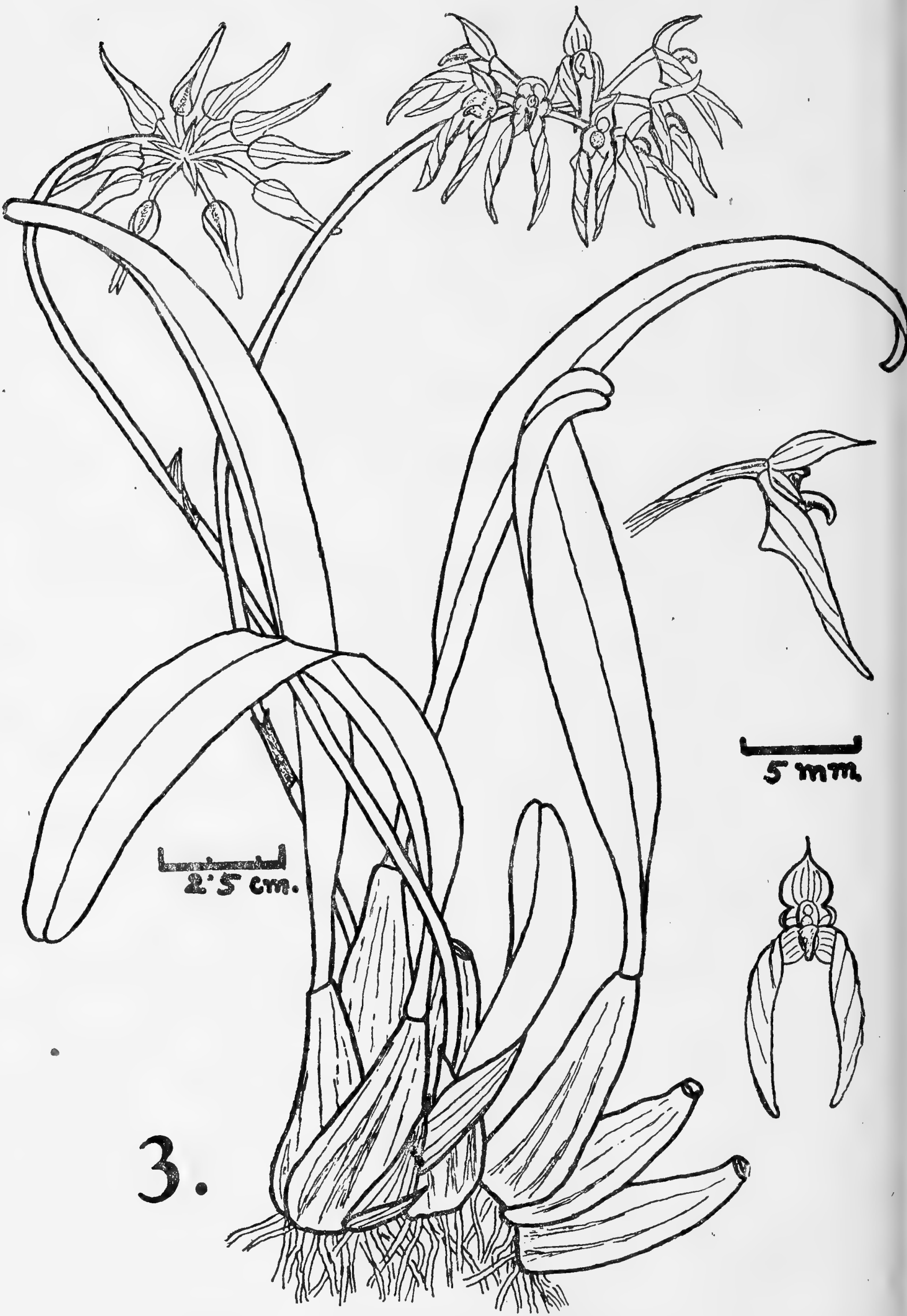


FIG. 3. *Cirrhopetalum elatum* Hk.f.

5-nerved, many times longer than the dorsal sepal; petals ovate, acute, ciliate, 3-nerved, green and blotched with purple-brown ; lip smooth. *Flowering* time during July and August ; distributed between 900 to 1200 m. Collected from Dhankutta.

C. elatum Hook. f. in F. B. I. 5 : 775, 1890. (Fig. 3).

Flowers yellow, sometimes speckled with purple, in umbels ; dorsal sepal small, orbicular, broadly ovate, obtuse, lateral sepals 2·5-3 cm. long, linear-lanceolate, acute, 5-nerved, 3-4 times longer than the dorsal sepal, petals ovate, tip apiculate ; lip convex. *Flowering* in June. Collected from Jiri, locality unknown (Herklott).

C. guttulatum Hook. f. in F. B. I. 5 : 776, 1890.

Sepals spreading, dorsal sepal broadly obtuse, 5-nerved, lateral sepals ovate-lanceolate, base broad, 7-nerved, twice as long as the dorsal sepal, yellow or greenish-yellow, speckled with purple; petals ovate, 3-nerved ; lip short, as long as broad, purplish. *Flowering* in September and October ; distributed between 1500 & 1800 m. Collected from Sheopuri and Sundarijal area. This species resembles *C. maculosum* but can be made out by the size of the scape, flowering time etc.

C. hookeri Duthie in Journ. Asiat. Soc. Bengal 71 (2) : 38, 1902.

Flowers 3 to 6, yellow ; dorsal sepal ovate, emarginate, concave, pale yellow with 3 purple veins, lateral sepals united at their bases and joined to the foot of the column, acuminate, tips cupulate, yellow with 3 purple veins which are more prominent towards the base ; petals shorter than the dorsal sepal, obliquely ovate, rounded, yellow with bases slightly purple ; lip deflexed, fleshy, yellow with purplish spots. *Flowering* during September and October ; distributed between 2100 to 2400 m. Collected from Daman and Borlong forests.

C. maculosum Lindl. Bot. Reg. Misc. 81, 1841 ; F.B.I. 5 : 776, 1890.

Flowers pale yellowish-green, unspotted ; dorsal sepal broadly ovate, acute, lateral sepals ovate-lanceolate, base broad, 7-nerved, twice as long as the dorsal sepal; petals small, ovate, acute, 3-nerved ; lip short, broad, stipitate. *Flowering* during March and April ; distributed between 1500 & 1800 m. Collected from Godavari only.

C. maculosum var. **fuscescens** Hook. f. in F. B. I. 5 : 776, 1890.

Flowers dull in colour, slightly pinkish. Only one specimen collected from Godavari.

C. refractum Zollinger in Flora 30 : 457, 1847 ; F.B.I. 5 : 779, 1890.

Flowers orange yellow or even deeper ; dorsal sepal lanceolate, acute, finely ciliate, 3-nerved, lateral sepals strap-shaped, acuminate, slightly cohering at the tips, many times longer than the dorsal sepal, orange-yellow or deeper; petals lanceolate, finely ciliate, 3-nerved; lip spotted red. *Flowering* time during September and October; collected at 1800 m. from Sheopuri.

Sunipia Lindl.

Tufted epiphytes with creeping rhizomes and narrow pseudobulbs. Leaf one, subsessile, many-nerved and coriaceous. Spike curved; flowers distichous, concealed by scarious or coriaceous bracts, rosy-pink; lip sessile on the base of the column, tongue-shaped and with an oblong callus; column very short; anthers sessile, distant or turned away from the rostellum.

Sunipia scariosa Lindl. Gen. et Spec. Orch. 179, 1830; F.B.I. 5: 772, 1890. *Ione scariosa* King & Pantl. 161, 1898.

Flowers small, subsessile, rosy and concealed by the bracts; sepals very broad, spreading, subequal, faintly 3-nerved; petals minute, rounded, ovate, fleshy; lip small, erect, broadly tongue-shaped, mid-lobe thick, oblong and with recurved margins. *Flowering* time May to June; distributed at 1200 to 1800 m. Collected from Sundarijal and Godavari.

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(*to be continued*)

Amphipoda from the East Coast of India—2

Gammaridea and Caprellidea

BY

T. E. Sivaprakasam

Zoological Survey of India, Southern Regional Station, Madras

(*With four text figures*)

Introduction

The first part of the systematic study of the Amphipoda of the east coast of India has already been published (Sivaprakasam 1966), wherein a survey of the literature on the subject, the details of materials and methods and a systematic account of 29 species belonging to nine gammaridean families were given. Some additional species have since been recorded, bringing the total number of species studied to 61, of which 33 species are newly recorded from India. The present paper, which is the second and concluding part of the study, deals with 32 species belonging to seven gammaridean families and the family Caprellidae, of which 16 species are newly recorded from India. The ecology and geographical distribution of all the amphipods studied here are discussed at the end of the paper.

SYSTEMATIC ACCOUNT

Family Talitridae

Genus *Orchestia* Leach

Orchestia anomala Chevreux

(Fig. 1)

Orchestia anomala Chevreux, 1901, p. 393, figs. 8-12 ; Schellenberg, 1938 (a), p. 65; Stephensen, 1947, p. 23 ; Ruffo, 1958, p. 42. *Talorchestia malayensis* Tattersall, 1922, p. 453, pl. 21, figs. 11-20 ; 1925, p. 241 ; Barnard, KH, 1955, p. 93.
Orchestia floresiana Stephensen, 1935(a), p. 24, figs. 4-6 ; Barnard, KH, 1935, p. 288, fig. 7.

Material : Kilakkarai : Several males and females from under stones at the tidal edge. Pondicherry : Several specimens from the loose soil around a freshwater pond in the Botanical garden. Tada, Pulicat Lake : Several specimens from the banks of salt-water ponds and canals.

Length : 13 mm.

Remarks : The present material closely agrees with Barnard's (1935) description of *O. floresiana*, synonymised with the present species by Schellenberg (1938). The flagellum of antenna 1 with 5 joints, the scabrous knobs on joints 4-6 in male gnathopod 1, the averted point of dactylus of gnathopod 2 of male, the numerous serrulations on hind margin of 2nd joint of peraeopod 5, the pleon segments 2 and 3 with submarginal ridges on lower margin and smooth hind margin are characteristic of this species.

From Tattersall's (1922) description of *T. malayensis*, it differs in having 5 joints instead of 3 in the flagellum of antenna 1, 6th joint of male gnathopod 2 not so broad, and telson not so shortly triangular (as observed by Barnard also).

Barnard (1935) united *T. malayensis* with his *O. floresiana* which were considered synonymous with *O. anomala* Chevreux by Schellenberg (1938). In 1955, Barnard again recorded *T. malayensis* from South Africa as a distinct species. But the presence of palm in the female gnathopod 1 in this species shows that it belongs to the genus *Orchestia*, and for the reasons advanced by Schellenberg, this species is united with the present one.

Distribution : Seychelles, South Africa, Singapore, Andaman Islands, Gulf of Siam, Philippines, Bismarck Archipelago, Comores, Marquesas, and India. The distribution of this species in India is extended from Lower Bengal to the whole east coast.

Genus *Talorchestia* Dana

Talorchestia martensii (Weber)

Orchestia martensii Weber, 1892, p. 564, figs. 13-16.
Talorchestia martensii Stebbing, 1906, p. 553 ; Chilton, 1921, p. 541, fig. 8 ; Stephensen, 1935(b), p. 10 ; Barnard, KH, 1935, p. 289 ; Ruffo, 1938(a), p. 169 ; Nayar, 1959, p. 28, pl. 10, figs. 1-9.
Talorchestia gracilis Chilton, 1925, p. 535 ; Gravely, 1927, p. 123.
Talorchestia affinis Maccagno, 1936, p. 181.

Material : Large number of specimens from all the stations, collected from the tidal edge, the sea shore, the banks of brackish and freshwater canals and ponds.

Length : 10 mm.

Remarks : This is the commonest terrestrial amphipod (sandhopper) on the east coast of India. It has been collected from the sea shore among sand and decaying seaweeds and also from the loose soil along estuaries, brackish and freshwater ponds.

Distribution : Flores (East Indies), Tale Sap (Thailand), India and Red Sea.

Family HYALELLIDAE

Genus *Parhyalella* Kunkel

Parhyalella indica Barnard

(Fig. 2)

Parhyalella indica Barnard, KH, 1935, p. 294, fig, 11 a-f.

Material : Kilakkarai : Several specimens from seaweeds. Rameswaram : 8 specimens from the algae growing on rocks. Devipattinam : Several specimens from Enteromorpha weeds. Nambuthalai : Several specimens from palmyra wood floating at the tidal edge. Point Calimere : 1 female from algae.

Length : 9 mm.

Description : Males: Body smooth, broadly rounded. Head rather small. Eyes large, dark, reniform with front margin straight. Antenna 1 one-third as long as body ; flagellum twice as long as peduncle, 16-17 jointed. Antenna 2 a little longer than antenna 1. 5th joint of peduncle longer than the preceding. Flagellum $1\frac{1}{2}$ times as long as peduncle, 17-jointed. Mouth parts typical of the genus.

Gnathopod 1 : Side plate large, oblong, distally rounded. 2nd joint with a few long setae in the middle and at distal end of hind margin. 3rd joint longer than 4th. 5th joint funnel-shaped, longer and wider than 6th ; front margin distally with a circlet of setae ; hind margin produced distally into a lobe with a circlet of setae. Hind margin widened a little distally and with a row of 4-5 setae. Palm convex, defined by 2 stout spines. Dactylus as long as palm, closely fitting with it. Gnathopod 2, large and well-developed. Side plate large, oblong. 2nd joint widening distally ; hind margin with 2 sets of long setae in the middle and one at the distal end. 3rd joint a little shorter than 4th, front margin with a distal lobe. 5th joint short, produced into a spoon-shaped lobe between 4th and 6th joints. 6th joint large, oval, tapering distally. Palm very oblique, convex, twice as long as hind margin ; with a row of spines on either side and ending in a pit with 3 spines ; behind this is a

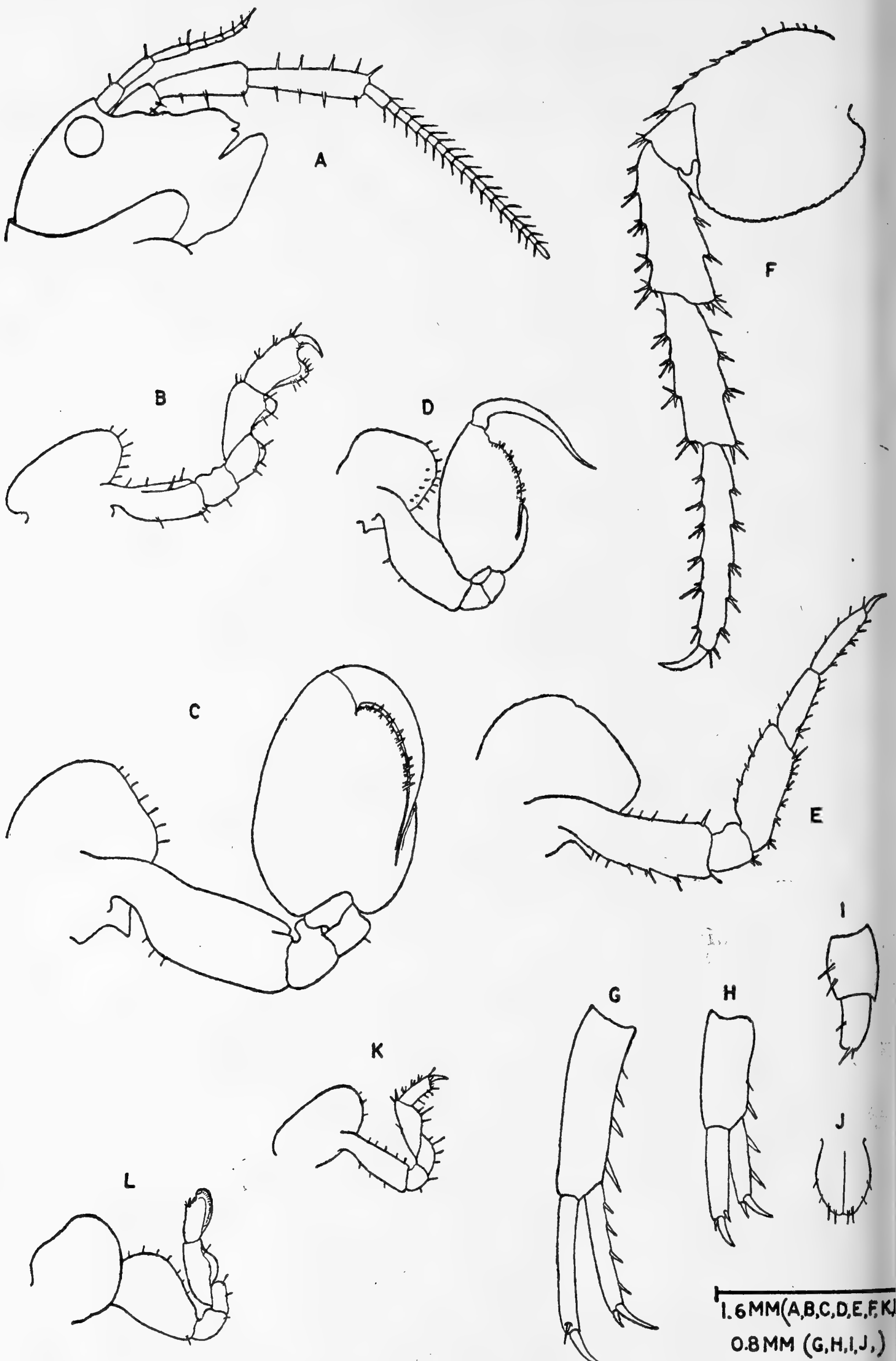

FIG. 1. *Orchestia anomala* Chevreux. MALE: A, head; B, gnathopod 1; C, gnathopod 2 of adult; D, gnathopod 2 of young; E, peraeopod 1; F, peraeopod 5; G, uropod 1; H, uropod 2; I, uropod 3; J, telson. FEMALE: K, gnathopod 1; L, gnathopod 2.

single spine and two notches each with a seta. Dactylus long and curved, its tip lying in the palmar pit.

Peraeopods 1 and 2 similar, slender. Side plate large, broader than long. 2nd joint widest at the middle, distal half of hind margin with 3 sets of long setae. Peraeopods 3-5 very spinous. Hind margin of 2nd joint rounded and smooth.

Uropod 1 : spinous, peduncle a little longer than rami. Uropod 2 : spinous ; peduncle as long as outer ramus which is shorter than inner. Uropod 3 : uniramous ; peduncle subequal to the ramus, both distally with a spine. Telson produced conically behind, with a seta near the tip on either side.

Female: Gnathopod 1 as in male, much smaller. Gnathopod 2 as in male but less developed. Side plate oblong, larger than in male. 2nd joint $1\frac{1}{2}$ times as long as 6th. Joints 3-5 as in male. 6th joint tapering distally. Palm very oblique, undefined, reaching hind lobe of 5th joint, with a dense brush of setae. Dactylus short, half as long as palm.

Remarks : Barnard (1935) gave a short description of the features in which *P. indica* differed from *P. natalensis*. The present material differs from his description in the antennal flagella having more joints (17 as in *P. natalensis*) ; palm of gnathopod 2 in female is not defined by a notch and 3 spines as in the male.

Distribution : India. This species was originally described from Tuticorin in the Gulf of Mannar. It has now been recorded from several localities in the Gulf of Mannar and Palk Bay.

Family HYALIDAE

Genus *Hyale* Rathke

Hyale nigra (Haswell)

(Fig. 3)

Allorchestes niger Haswell, 1880(b), p. 319 ; 1885, p. 96, pl. 11, figs. 1-3.
Hyale nigra Stebbing, 1906, p. 571 ; Schellenberg, 1928, p. 659, fig. 204 ; Barnard KH, 1937, p. 162.
Hyale nilssoni Walker & Scott, 1903, p. 219, pl. 14A, fig. 3.

Material : Cape Comorin : Several specimens from seaweeds. Kilakkarai : 3 females from seaweeds. Pamban : 6 specimens from seaweeds.

Length : 6·5 mm.

Remarks : The present material is very similar to Schellenberg's (1928) description and figures of this species from the Suez Canal.

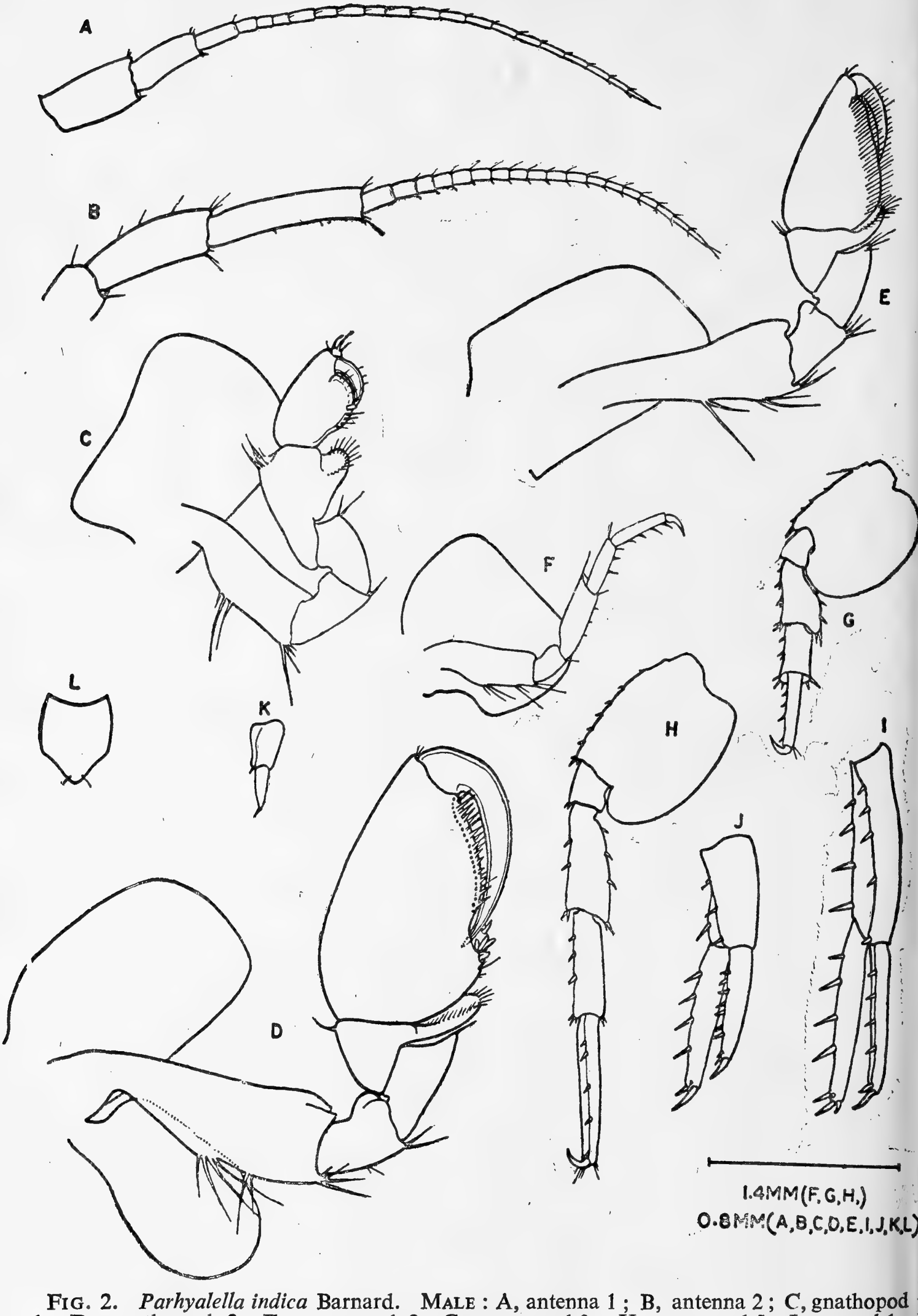

FIG. 2. *Parhyalella indica* Barnard. MALE : A, antenna 1 ; B, antenna 2 ; C, gnathopod 1 ; D, gnathopod 2 ; F, peraeopod 2 ; G, peraeopod 3 ; H, peraeopod 5 ; I, uropod 1 ; J, uropod 2 ; K, uropod 3 ; L, telson. FEMALE : E, gnathopod 2.

Walker & Scott's (1903) record of *H. nilssoni* from the Sokotra Island is similar to this species, particularly in the form of male gnathopods 1 and 2, and is therefore united with the present species. Barnard (1935) united it with *H. brevipes* Chevreux which has since been synonymised with *Parhyale hawaiensis* (Dana) by Shoemaker (1956).

Distribution : Australia, Suez Canal, South Arabian coast, Sokotra Island, and India. This species is recorded for the first time from India.

Hyale ayeli Barnard

Hyale ayeli Barnard JL, 1955, p. 14, fig. 7.

Material : Rameswaram : 3 males and 4 females from seaweeds.

Length : 7 mm.

Remarks : These specimens closely agree with Barnard's (1955) description and figures, and differ from *H. media* (Dana), a closely related species in the following points :—Antenna 1 : $\frac{3}{4}$ as long as antenna 2, flagellum with 9-10 joints. Antenna 2 a little longer than $\frac{1}{4}$ body length. Flagellum with 11-14 joints. Lower margin of 4th and 5th peduncular joints and 1st to 7th flagellar joints with thick tufts of setae. Gnathopod 1 of male : 6th joint longer than 5th, rectangular ; palm slightly oblique and convex. Gnathopod 2 of male : 2nd and 3rd joints produced into a lobe on front margin. 6th joint large, oval, palm defined by 2 spines. Dactylus stout, strongly curved at the base and near the tip. Gnathopod 2 of female similar to gnathopod 1 but larger. 6th joint rectangular, palm oblique and defined by 2 spines.

Distribution : Hawaii Islands. This is the first record of this species from India.

Hyale affinis Chevreux

Hyale affinis Chevreux, 1908, p. 503, figs. 21-22 ; Schellenberg, 1938 (a), p. 67; Barnard JL, 1955, p. 14, fig. 6.

Material : Madras harbour : Several specimens from algae growing on concrete blocks.

Length : 7·5 mm.

Remarks : Schellenberg's (1938) comparison of his material from Hawaii with those from Gambier Archipelago described by Chevreux, shows that this species is variable. The present material resembles both their descriptions, while agreeing more with Chevreux's description. The specimens are larger, 7·5 mm. in length. Eyes moderate sized, dark,

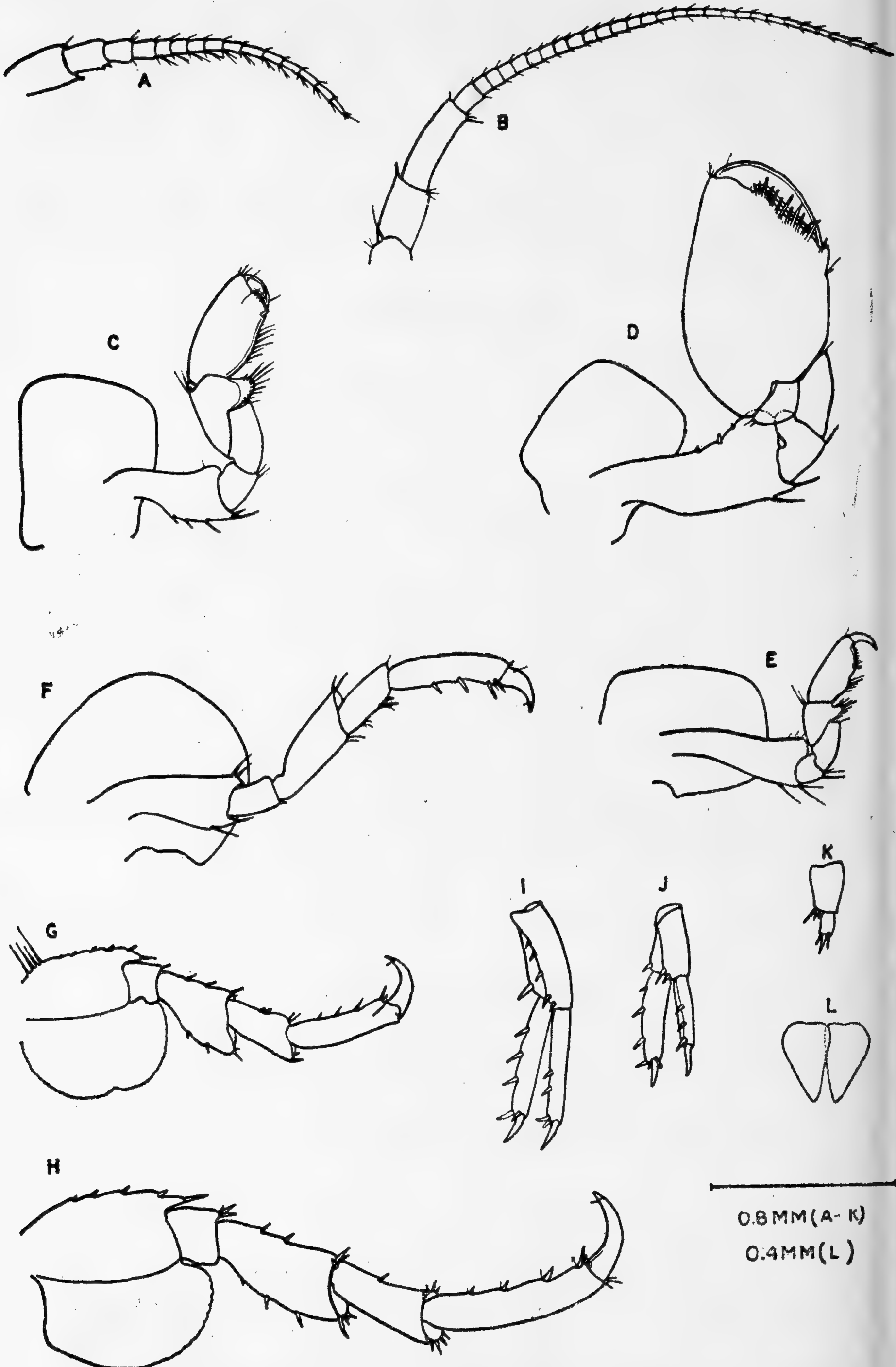

FIG. 3. *Hyale nigra* (Haswell), MALE: A, antenna 1; B, antenna 2; C, gnathopod 1; D, gnathopod 2; F, peraeopod 2; G, peraeopod 3; H, peraeopod 5; I, uropod 1; J, uropod 2; K, uropod 3; L, telson. FEMALE: E, gnathopod 2.

somewhat oval. Side plate of peraeopod 2 with a hind lobe. Antenna 1 with 2nd and 3rd peduncular joints subequal in length and flagellum with 14-16 joints. Flagellum of antenna 2 with 30-32 joints. Gnathopod 1 of male with front margin of 6th joint distally produced into a hump-like process. Gnathopod 2 of male with hind margin of 6th joint about $\frac{1}{2}$ as long as palm which is bordered on both sides by long spinules and defined below by 2 stout blunt spines. Peraeopods 1-5 : 6th joint with 4-5 spines, the penultimate one being long, stout and blunt and distinct from others. Dactylus with a subdistal setule on inner margin. Uropod 1 : Rami subequal. End spine on peduncle less than half as long as outer ramus. Uropod 3 with ramus subequal to peduncle. Female gnathopods : 6th joint more than double as long as wide ; hind margin with a fascicle of 3 setae in the middle. Palm more oblique than shown by Barnard (1955).

Distribution : Gambier Archipelago, and Hawaii Islands. This species is recorded for the first time from India.

Hyale chevreuxi Barnard

(Fig. 4 A-C)

Hyale chevreuxi Barnard KH, 1916, p. 235 ; Schellenberg, 1938 (a), p. 68, fig. 35a.
Hyale macrodactylus Chevreux, 1901, p. 397, figs. 13-14 ; Walker, 1909, p. 337. (not Stebbing, 1899).

Material : Several hundred specimens from seaweeds collected from Cape Comorin, Kilakkarai, Pamban and Madras harbour.

Length : 7 mm.

Remarks : The present material agrees well with Schellenberg's (1938) description and figure of this species. Head $1\frac{1}{3}$ as long as first segment. Eyes medium-sized, round and dark. Antenna 1 about half as long as antenna 2 ; flagellum with 13-15 joints. Antenna 2 more than half the body length ; flagellum with 27-33 joints. Gnathopod 1 of male : Side plate longer than deep, widened below. 2nd joint narrow at the base and widening distally. 3rd joint lobed in front, 6th joint triangular, the ratio of length to width 7 : 4 ; front margin convex ; hind margin straight near its junction with palm and concave proximally. Palm short, oblique, defined by a spine. Dactylus rather slender. Gnathopod 2 of male : Side plate quadrate. 2nd joint narrow at the base and widening distally ; hind margin with 4 sets of spinules and front margin expanded, with close-set setae (about 20 in number). 3rd joint lobed in front. 6th joint large, elongate-oval in form ; front margin naked except for a spinule near the base ; hind margin 2/5 as long as palm.

Palm very oblique, slightly convex, bordered by a thick comb of setae on the inner aspect and by both spinules and setae on the outer. Dactylus

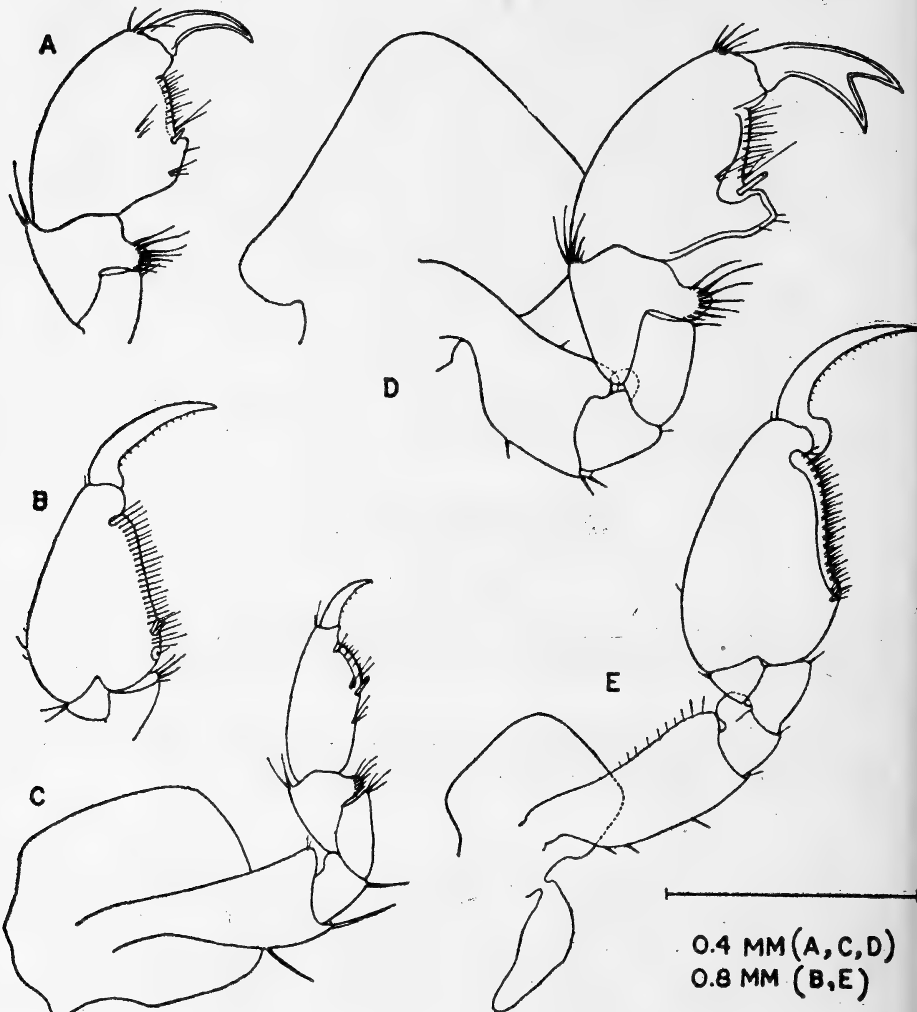

FIG. 4.—A-C : *Hyale chevreuxi* Barnard. A, gnathopod 1 of male ; B, gnathopod 2 of male ; C, gnathopod 2 of female. D-E : *Hyale diplodactyla* Stebbing. D, gnathopod 1 of male ; E, gnathopod 2 of male.

as long as palm, smoothly narrowing, with setules on inner margin. Peraeopods : 6th joint with 5 slender spines gradually increasing in length, the last one being shorter. Dactylus with a setule near its tip. Side plate of peraeopod 2 produced behind. 2nd joint imperfectly serrate in peraeopods 3-5 and with an indent in the middle in peraeopods 3-4. Uropod 1 : Peduncle longer than rami, with a terminal spine. Uropod 2 : Outer ramus longer than the inner which is subequal to peduncle. Uropod 3 : Peduncle longer than ramus. Telson lobes long, conical and pointed behind. Female gnathopod 1 a little smaller than gnathopod 2, otherwise identical. 6th joint nearly rectangular, the ratio of length to width being 7 : 3. Hind margin with a set of 3-4 setae in the middle. Palm slightly oblique, defined by 2 spines.

Distribution : Seychelles, Chagos Archipelago, and Gilbert Island (South Pacific Ocean). This is the first record of this species from India.

Hyale diplodactyla Stebbing

(Fig. 4 D-E)

Hyale diplodactylus Stebbing, 1899, p. 403, pl. 31C.; 1906, p. 562, fig. 95 ; Ruffo, 1956, p. 213.

Material : Cape Comorin : 2 males and 1 female from seaweeds. Pamban : Several specimens from seaweeds.

Length : 6 mm.

Remarks : The present material closely agrees with Stebbing's (1899) description and figures. Eyes are medium-sized, round and dark. Antenna 1 half as long as antenna 2 ; flagellum with about 13 joints. Antenna 2 less than half as long as body ; flagellum with about 27 joints, inner margin with short, thick setae. Gnathopod 1 of male : Side plate longer than broad, slightly widened below. 2nd joint narrow proximally and widening distally ; front margin produced. 3rd joint lobed in front. 6th joint somewhat triangular with front margin convex and hind margin concave. Palm oblique, concave and defined by a blunt spine ; the junction of palm and hind margin produced into an angular lobe with a fascicle of setae ; palm excavated into a pocket on the inner aspect to receive the tip of dactylus. Dactylus deeply bifurcated from its tip to about $\frac{1}{3}$ its length. The bifurcation of the dactylus appears to take place at a late stage of the animal. In a 5 mm. long specimen the dactylus was not bifurcate but had a swelling on the outer side at about $\frac{1}{3}$ its length from the tip. In a still larger specimen (5·5 mm.) the dactylus of the right side was in this condition and the left one was bifurcate. Gnathopod 2 of male : Side plate quadrate. 2nd joint widening distally ; front margin expanded in front, with rather close-set setae (about 12 in number). 3rd joint lobed in front. 6th joint large, elongate-oval in form, widest at the base. Front margin with 2 separate spines in the proximal $\frac{1}{3}$ of its length. Hind margin shorter than palm. Palm very oblique, slightly convex, bordered on both sides by spinules, large ones alternating with short ones, and ending in a pocket with 2 blunt spines to receive the tip of dactylus. Dactylus as long as palm, with a rounded tooth at the base. Peraeopods, uropods, telson and the female as described above for *H. chevreuxi.*

Distribution : West Indies and India.

Hyale macrodactyla Stebbing

Hyale macrodactylus Stebbing, 1899, p. 404, pl. 31D.
Hyale macrodactyla Stebbing, 1906, p. 564, fig. 96 ; Barnard KH, 1916, p. 235 ; Schellenberg, 1939, p. 129 ; Ruffo, 1954, p. 119.

Material : Several hundred specimens from seaweeds collected from Pamban, Kovelong, Madras Harbour and Royapuram.

Length : 7·5 mm.

Remarks : The present material agrees well with Stebbing's (1899) description and figures except that they are much larger and that there is no emargination between two slight swellings in the distal part of palm of male gnathopod 2.

The antennae and the gnathopods of male undergo considerable changes with growth. In a juvenile 4 mm. in length, flagellum of antenna 1 had 12 joints and that of antenna 2 had 24 joints. 6th joint of gnathopod 1 nearly rectangular, 2·1 as long as broad. 6th joint of gnathopod 2 with palm as long as hind margin. In a larger male (5 mm.) 6th joint of gnathopod 1 was elliptical, 1·7 as long as broadest portion.

In the adult males (7·5 mm.), eyes were rather large, dark and round. Antenna 1 half as long as antenna 2, flagellum with 15-16 joints. Antenna 2 less than half body length, flagellum with 29-30 joints. Gnathopod 1 : Side plate longer than deep, slightly widened below. 2nd joint narrow at the base ; front margin expanded distally with 2 spinules. 3rd joint lobed in front. 6th joint oblong-oval, 1·6 as long as widest portion. Palm oblique, convex, defined by 2 blunt spines. Hind margin angularly produced, proximal $\frac{2}{3}$ straight, ending in a fascicle of 2-3 setae which separate the distal $\frac{1}{3}$ which is rounded and continuous with the palm. Dactylus stout, curved, and a little longer than palm. Gnathopod 2 : Side plate quadrate. 2nd joint distally lobed in front, with 1 or 2 setules. 3rd joint lobed in front. 5th joint with a stout distal spine on front margin. 6th joint large, elongate, widest at the base. Front margin naked. Palm extending over the whole length of the joint, nearly straight, the distal part slightly convex and the proximal slightly concave and ending in a pocket with 2 blunt spines ; palm bordered on both sides by continuous rows of slender spinules. Dactylus reaching end of 4th joint, wider in the middle and blunt at the tip. Peraeopods : Dactylus stout, curved and with a subterminal setule. 6th joint in peraeopods 1-3 with 4 spines, the third being enlarged into a stout, blunt spine. 6th joint in peraeopods 4-5 with 5 spines of which 4th is enlarged into a stout blunt spine. 2nd joint orbicular in peraeopods 3 and 5 and oblong in 4th ; hind margin imperfectly serrate in all and with a middle notch in peraeopod 3. Hind corner of 3rd epimere not acute. Uropod 1 : Peduncle as long as outer ramus with an enlarged distal spine. Uropod 2 : Peduncle as long as outer ramus which is shorter than inner. Uropod 3 : Peduncle as long as ramus. Telson lobes longer than broad, conical behind.

Female: Gnathopod 1 similar to the next but a little smaller. Gnathopod 2: 6th joint rectangular, twice as long as broad. Palm oblique, convex, defined by 2 spines. Hind margin longer than palm, demarcated by a set of setae into proximal convex part and distal concave part. Dactylus rather stout.

Nayar's (1959) record of *H. honoluluensis* appears to be this species. The male gnathopods are more like *H. macrodactyla.*

Distribution: West Indies, Brazil, Venezuela, Senegal, South Africa and Congo. This is the first record of this species from India.

(*to be continued*)

A Study on the Aquatic Coleoptera of Poona (Maharashtra)

BY

G. T. Tonapi and V. A. Ozarkar

Department of Zoology, University of Poona, Poona 7 (Maharashtra)

(*With four plates*)

Introduction

During the course of studies on respiration of aquatic beetles it became evident that available information on the Indian aquatic beetles is meagre. The group as a whole has received adequate attention from taxonomists and morphologists. However, field observations on this interesting group are few and available literature like, the voluminous work of Sharp (1882) or the more recent contribution of Balfour-Browne (1958) form excellent aids in the laboratory but cannot be profitably used in field.

This paper is an attempt to provide the naturalist or the professional biologist such as a fishery worker or a limnologist not only with the distribution and composition of this group in specific habitats but also to provide characters to identify them in the field.

Topography of the region

Poona (*c.* 18°31′ N., 73°51′ E.) situated at the confluence of the rivers Mula and Mutha is about 564 metres above mean sea-level and about 100 kilometres east in a straight line from the western coast. The city lies in the shadow of the western ghats. The average mean rainfall of the region is 500 mm. In addition to the large perennial tanks like Pashan and Katraj which provide a safe sanctuary to these beetles even temporary streams, built-up ponds, disused wells, semi-permanent pools and canals provide protective shelter even if occasionally they go dry.

Methods

Collection of specimens was made almost regularly once a fortnight. Weather permitting, the frequency and duration of these visits was increased. Most of the collection was made by handnets. At times a drift net was prepared and used. Except for the species *Orectochilus discifer* Walker[1] which was collected from Khandala (altitude 900 metres) all other species have been collected from Poona and its surroundings. In the text descriptions are followed by the average measurements of about five specimens taken at random and collected at a particular time. The exact localities and the area of exploration with detailed information on the meteorological conditions have been given earlier (Tonapi 1959, Tonapi & Mulherkar 1963 a).

A simple method was adopted to determine their relative availability. Whenever a specimen was noted at a particular habitat a net of 10 inches diameter was used to sweep the spot three times and attempts were made to capture all the specimens. The number of specimens was then counted. If more than twenty-five specimens were collected during three sweepings, the species was considered to be abundant. If ten specimens were collected the species has been treated as common. If the specimens collected were less than five it has been indicated as uncommon. However, if only a specimen or two were collected at a time and the species was not noticed again then it has been dealt with as rare. It is realised that this system does not truly reflect the relative abundance of a species but the quantitative aspects are not being given importance at the moment.

Systematic List

Family Dytiscidae

Cybister limbatus Fabr. (Plate I, fig. 1)

Body obovate with the posterior end slightly pointed. Brown in colour with a greenish tinge. A conspicuously broad yellow band runs along the margins of the pronotum and the elytra. Pronotum and elytra of female impressed with lines of varying lengths which sometimes anastomose. Male pronotum and elytra smooth, with rows of distinct punctures. Underside almost dark brown with yellow patches on the lateral side of the sternal plates. Both the front pairs of legs have tarsal dilations with conspicuous cupules on the forelegs and with spongy hair-like outgrowths on the middle legs.

This is the most common species frequently seen in quarries and ponds.

Status and Habitat : Abundant in ponds and quarries.

Measurements : Length 43 mm.; Breadth 20·5 mm.

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[1] A couple of species of this interesting genus are available in the environs of Poona. However, their exact identity has not been determined.

Cybister confusus Sharp

Differs from *C. limbatus* in being a little smaller and less stocky. Meso- and metasternal abdominal plates less heavily sclerotised and are translucent. It agrees with the general description of *Cybister limbatus* Fabr. in other respects.

Status and Habitat : Common. Pools, quarries and wells.

Measurements : Length 38 mm.; Breadth 19 mm.

Cybister tripunctatus asiaticus Sharp

Moderate-sized species resembling *Cybister confusus* Sharp in its brownish colour and lateral yellow margins on the elytra. Pronotum and elytra smooth in both sexes, the latter with four rows of distinct punctures. Sternum and the sternal abdominal plates are not heavily sclerotised, some areas almost transparent. Both the front pairs of legs are provided with tarsal dilations, the first with cupules and the second pair with spongy hairs.

The species is very widely distributed in Indo-Malayan region (Vazirani 1952).

Status and Habitat : Abundant. Quarries, pools, wells and river banks.

Measurements : Length 28 mm. ; Breadth 14 mm.

Cybister rugulosus Redt. (Plate I, fig. 2)

Uniform dark brown in colour. Pronotum and elytra smooth in both the sexes. Sternum and sternal abdominal plates, dark brown with heavy sclerotization. Only the first pair of legs is provided with tarsal dilations and cupules.

Status and Habitat : Uncommon. Pools, quarries and wells.

Measurements : Length 25 mm. ; Breadth 11 mm.

Hydaticus luczonicus Aube (Plate I, fig. 3)

This medium-sized beetle has glossy elytra, with the yellow border on the lateral sides stippled with brownish dots. Rest of the elytra dark brown but the pronotum has the anterior, lateral and posterior margins, yellow. The colour pattern on the pronotum and the elytra appears distinctive to the species. In males both the front pairs of legs have tarsal dilations with cupules.

Status and Habitat : Common. Quarries, pools and wells.

Measurements : Length 14·5 mm. ; Breadth 8·5 mm.

Tonapi: Aquatic coleoptera.

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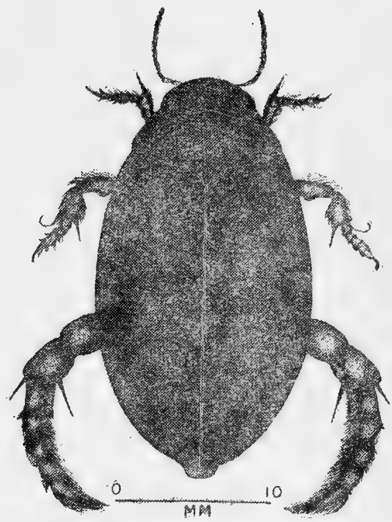

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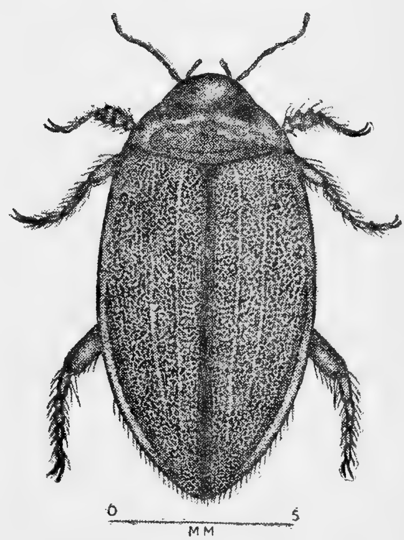

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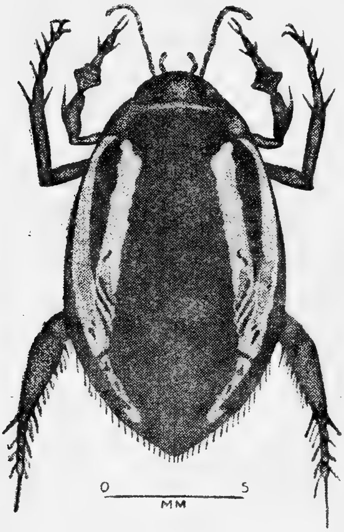
1. *Cybister limbatus* Fabr.; 2. *Cybister rugulosus* Redt.; 3. *Hydaticus luczonicus* Abeu.; 4. *Hydaticus fabricii* MacLeay.

Tonapi: Aquatic coleoptera.



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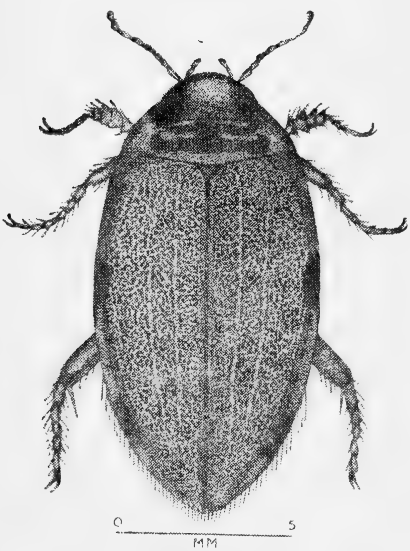

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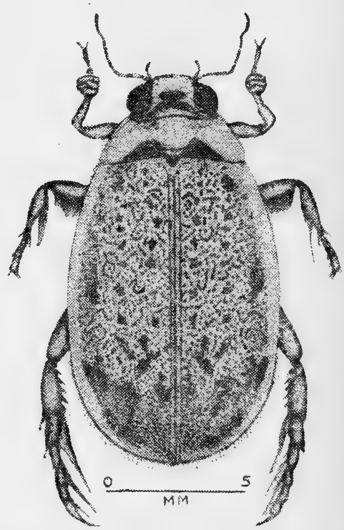

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5. *Hydrocoptus subvittatus* Motsch.; 6. *Sandracottus festivus* Illiger ; 7. *Rhantaticus congestus* Klug.; 8. *Eretes sticticus* L.?

Hydaticus fabricii MacLeay (Plate I, fig. 4)

Body oval, with pronotum and elytra testaceous but bright. Black spots on the elytra diffused and vermiculate. Elytral edges particularly the posterior and the lateral ones fringed with hairs. Both the front pairs of legs in males have tarsal dilations and cupules.

Status and Habitat : Uncommon. Quarries, pools and wells.

Measurements : Length 11 mm. ; Breadth 5·5 mm.

Hydrocoptus subvittatus Motsch. (Plate II, fig. 5)

Elytra bright with creamy yellow border on the lateral sides. Lateral margins of the pronotum creamy yellow. Basal portion of head capsule brown ; frontal part testaceous. The males have both the front pairs of legs with tarsal dilations and cupules.

Mendis & Fernando (1962) refer to its occurrence in Ceylon and it is apparently very common in the Indian peninsula.

Status and Habitat : Abundant. pools, quarries, streams, wells and temporary water courses.

Measurements : Length 13 mm. ; Breadth 7·5 mm.

Sandracottus festivus Illiger (Plate II, fig. 6)

Broadly oval in general shape. Pronotum and elytra nitid. Elytra yellow with prominent dark black markings which seem to be species specific. Sternum and sternal abdominal plates black and smooth. The posterior lateral edges fringed with few hairs. The males have both the front pairs of legs with tarsal dilations and cupules.

Status and Habitat : Uncommon. Pools, quarries, wells and temporary water courses.

Measurements : Length 14 mm. ; Breadth 6·5 mm.

Rhantaticus congestus Klug. (Plate II, fig. 7)

Oval in general outline with pronotum and elytra bright and glossy. Elytra testaceous with markings similar to those of *Hydaticus fabricii* MacLeay. They however differ in having two dense patches of markings on the lateral margins of elytra. Posterior lateral edges of elytra provided with few fringe hairs. In males both front pairs of legs have tarsal dilations and cupules.

Status and Habitat : Uncommon. Pools, quarries, wells and temporary water courses.

Measurements : Length 13 mm. ; Breadth 6 mm.

Eretes sticticus L. (?) (Plate II, fig. 8)

Oblong oval in shape. Pronotum and elytra bright and lustrous. Elytra with rows of black spots more concentrated on the posterior side. Meso- and metasternum and the sternal abdominal plates feebly sclerotised and hence more or less transparent. Both front pairs of legs have tarsal dilations with cupules.

This species is very agile and takes to flight immediately after leaving water unlike some other aquatic beetles like the Gyrinids (Carthy 1962). It is reported as very common almost all over Ceylon (Mendis & Fernando 1962).

Status and Habitat : Common. Pools, quarries and wells.
Measurements : Length 13 mm. ; Breadth 6 mm.

Laccophilus chinensis inefficiens Boh. (Plate III, fig. 9)

Body ovate, nearly elliptical but narrowed posteriorly. Prothorax very short. Elytra widest near the centre, and are testaceous with black markings. Tarsi of the first two pairs of legs in males enlarged and provided with spongy hairs.

These beetles can hop with agility outside the water. This is the most common species amongst the small-sized beetles. They are found more on the sides of the ponds.

Status and Habitat : Abundant. Quarries, pools and river banks.
Measurements : Length 4·5 mm. ; Breadth 2 mm.

Laccophilus parvulus Aube (Plate III, fig. 10)

This species is a little larger and stouter than the preceding species. General body colour testaceous with very faint black markings on elytra. Both the front pairs of legs in males with spongy hairs on the slightly enlarged tarsal plates.

Status and Habitat : Common. Quarries, pools and river banks.
Measurements : Length 5 mm. ; Breadth 2·3 mm.

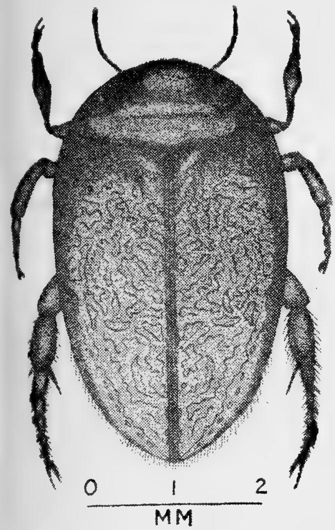
Laccophilus anticatus Sharp (Plate III, fig. 11)

Body ovate. Head, thorax and the elytra are pitchy with distinct yellow patches on the latter. Underpart is also pitchy.

A rare species amongst the genus *Laccophilus* and usually found in association with partially submerged floating vegetation on the banks of ponds.

Status and Habitat : Rare. Pools and quarries.
Measurements : Length 4 mm. ; Breadth 2 mm.

Tonapi: Aquatic coleoptera.



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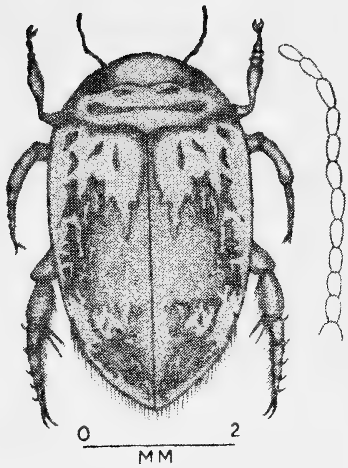

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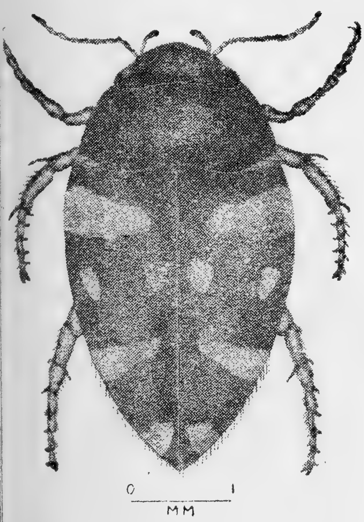

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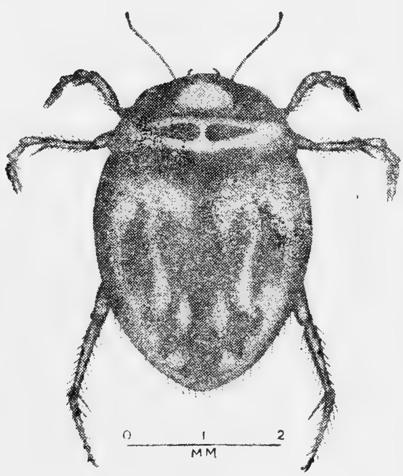

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9. *Laccophilus chinensis inefficiens* Boh.; 10. *Laccophilus parvulus* Aube;
11. *Laccophilus anticatus* Sharp; 12. *Hyphydrus indicus* Sharp.

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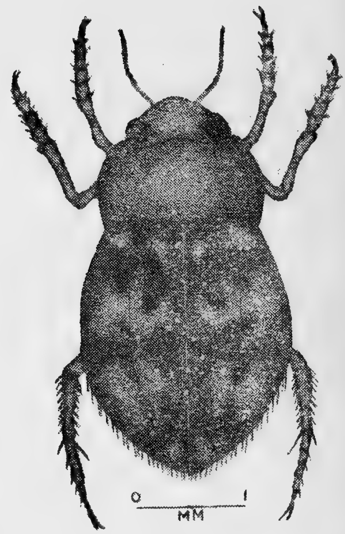

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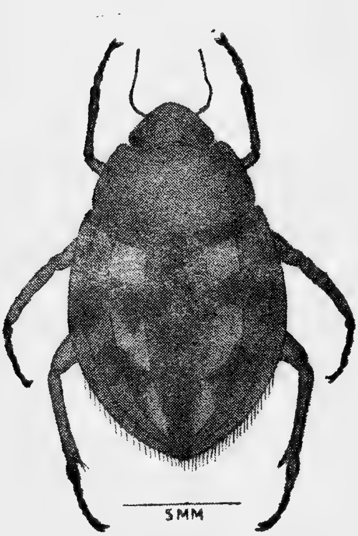

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13. *Hyphoporous* sp.; 14. *Peschetius quadricostatus* (Aube); 15. *Yola consanguinea* Regimbart; 16. *Dineutes indicus* Aube.

Hyphydrus indicus Sharp (Plate III, fig. 12)

General shape, circular. Elytra sculptured, testaceous, and with brown vertical patches. Posterior and lateral edges of elytra fringed with hairs. Front pairs of legs of males with spongy hairs on the slightly enlarged tarsal plates. The last but one tarsal segment is brownish but otherwise the leg is testaceous.

Status and Habitat : Common. Pools, quarries and wells.

Measurements : Length 3·5-4 mm. ; Breadth 2·5 mm.

Hyphoporous sp. (Plate IV, fig. 13)

Resembles *Hyphydrus indicus* Sharp but the specific colour pattern on the elytra and the completely testaceous legs distinguish this species from the latter even in the field.

Status and Habitat : Uncommon. Pools, quarries and wells.

Measurements : Length 3·5 mm. ; Breadth 2 mm.

Peschetius quadricostatus (Aube) (Plate IV, fig. 14)

General body outline elliptical, narrowing posteriorly. Elytra testaceous with brown patches and sculptured throughout. Elytra have two ridges on each side. The tarsi of the front two pairs of legs provided with spongy hairs.

Status and Habitat : Rare. Pools.

Measurements : Length 3·5 mm. ; Breadth 1·7-1·9 mm.

Yola consanguinea Regimbart (Plate IV, fig. 15)

Small obovate insects. Head, thorax and elytra, testaceous with brown patches. The elytra are sculptured and ridged as in *Peschetius quadricostatus* (Aube). The metasternum has an anteriorly directed deep groove.

This species along with *Peschetius quadricostatus* occur in limited numbers on the banks of ponds mostly associated with partially submerged rooted aquatic vegetation.

Status and Habitat : Rare. Pools and wells.

Measurements : Length 1·5 mm. ; Breadth 1 mm.

Family Gyrinidae

Dineutes indicus Aube (Plate IV, fig. 16)

General body shape, elliptical. Last segment in females and last two segments in males exposed behind the elytra. Both dorsal and ventral surfaces distinctly convex. Upper and under surface black but ventor more nitid. Both the hindlegs are flattened to form paddles which are used for swimming. The front pair of legs in males is provided with spongy hairs on the tarsal plate.

These beetles prefer clear waters preferably the rocky pools formed in rapidly flowing streams.

Status and Habitat : Streams and temporary water courses.

Measurements : Length 15 mm. ; Breadth 6·5-7 mm.

(*to be continued*)

Gestation period in some Indian Bats

BY

A. GOPALAKRISHNA

Department of Zoology, College of Science, Nagpur

Data regarding the pregnancy record of several species of Indian bats collected through many years are presented along with relevant notes about the season of pregnancy and the body weights of the adults and of the new-born young. Ecological and physiological factors are discussed in relation to gestation in bats. It is concluded that the length of gestation is basically genetically determined. The duration and the season of pregnancy are so adjusted that the young are delivered during the time of the year when environmental conditions are at optimum.

INTRODUCTION

Over the past 20 years extensive investigations have been carried out in this laboratory on the breeding habits and various aspects of reproductive physiology of several Indian species of bats. During these investigations complete and accurate records of the gestation periods in several species of bats have been carefully maintained. Since there is no systematic and comprehensive record of the gestation periods of Indian bats, it was felt that a report on the subject with notes on the pregnancy seasons in these species would be of considerable interest and value to future investigators on this subject, and to workers interested in the ecology and the natural history of these bats.

There seems to be an approximate direct relationship between the size of the body of the eutherian mammal and the duration of pregnancy in it, and usually the larger the mammal the longer is the period of gestation. However, this correlation between the size of the body and the length of gestation is modified by various factors such as the size of the litter, the occurrence of hibernation, prolonged pregnancy due to delayed implantation of the blastocyst and so on. Generally, among eutherian mammals of approximately the same adult size the monotocous species have a longer gestation than the polytocous ones, and in the latter the larger the litter size the shorter the duration of pregnancy. If hibernation overlaps the breeding season, the gestation period is prolonged either due to delayed implantation of the blastocyst or due to the slowing down of the rate of development of the foetus. The size of the new-born young has also some relationship to the size of the litter and the duration of pregnancy.

The study of gestation in bats is of considerable interest because of the extraordinary morphological and physiological adaptations seen in these animals, and because of the great range of variations in size, reproductive habits and food among the different species. The adults of the fruit-bats of India and Australia (*Pteropus*) weigh nearly 900 gm., while some of the insectivorous bats weigh just 4·5 gm. (Baker & Bird 1936). Bats are cosmopolitan in distribution, and exhibit various reproductive adaptations to suit the ecological conditions of their habitats. Further, they have an abnormal inverted resting posture due to which the gestation sac in the bats rests on the diaphragm instead of on the pelvis or on the ventral abdominal wall as in other mammals. The relatively large size of the new-born young in the bats has resulted in the adaptation of the pelvic ligament of the mother in such a way that the pelvic symphysis becomes greatly stretched during parturition to allow the passage of the large young. Also, the wing and the interfemoral membrane together become converted into a receptacle to receive the young at delivery in many species. Whereas the food of a given species of bat is quite specific, it varies among the different species of bats. Thus, some are exclusively frugivorous, some insectivorous, some sanguivorous, some carnivorous and a few nectorivorous. These differences in the food habits have some bearing on the reproductive activities of the bats, because these animals have to choose the most propitious period in the year for delivering the young so that the mother in lactation, as well as the young one after weaning,may be assured of sufficient food supply. Thus, the extreme morphological and physiological specializations seen in these animals, and the ecological conditions in which they live have considerably influenced the reproductive habits of the bats. The season of copulation, the duration of pregnancy, and the number and size of the young in each litter are closely related to these factors.

Observations and discussion

In Table 1 are presented data relating to certain aspects of the breeding habits of some of the Indian bats, which have been studied in this laboratory. Against each species the period of the year, when pregnant specimens are present, is mentioned under the column 'Pregnancy season'. All the species mentioned in the table have a strict breeding season in the year. In most species the 'Pregnancy season' is longer than the gestation period of the individual specimen because all the female specimens of a species, and within a colony, do not copulate on the same day. Consequently all deliveries do not occur on the same day within a colony. But all the adult females copulate within a short period in the breeding season, and all deliveries take place within a short period. The gestation period for each species has been calculated as follows :—The date on which fertilization was first noticed (or calculated from the age of the earliest developmental stage seen) was noted. Similarly the date, on which the first delivery occurred in the colony, was also noted. The number of days between these two dates was calculated. In the same manner, the number of days was calculated between the last date (in the copulation season), when fertilization was noticed, to the last date, when delivery occurred in the colony. The average of the two calculated number of days is taken as the correct gestation period for the species. Since the pregnancy record is maintained for several successive years the gestation period has been verified year after year. In none of the species studied is there anything comparable to delayed implantation, because, in all the species, fertilization is immediately followed by pregnancy. Also, none of the species studied experiences hibernation so that the possibility of slowing down of development does not occur.

The gestation period is known with reasonable certainty in only a few species of bats. Table 2 gives the data pertaining to the gestation period of bats other than those mentioned in Table 1.

The examination of the two tables (Tables 1 and 2) reveal certain interesting features. The large fruit-bats *Pteropus giganteus* and *Pteropus geddiei* (Baker & Baker 1936) weighing from 600 to 900 gm. have about the same gestation period as *Hipposideros ater* weighing only 5 to 7 gm. Secondly, *Hipposideros fulvus fulvus*, and *Pipistrellus ceylonicus chrysothrix* have almost the same body weight, but the gestation period varies in them, being 155 to 160 days in the former and 50 to 55 days in the latter. In all these cases the new born young is relatively large in size and weighs between 15% to 25% of the adult body weight. These comparisons indicate that, among bats, the duration of pregnancy is not directly related to the size of the adult or to the size of the new born young. The litter size also does not have any bearing on the length of gestation, because, both among the monotocous species as well as among the polytocous ones, there are marked variations in the duration of pregnancy. Food and ecological conditions also do not seem to influence gestation directly as evidenced by the fact that *Hipposideros fulvus fulvus* and *Pipistrellus ceylonicus chrysothrix* live in the same localities and under the same conditions, they have the same size of the body and their food habits are the same, but their gestation periods are very different.

From the foregoing it is evident that the factors governing the gestation period in bats are far more intricate than those mentioned earlier for the eutherian mammals in general. An extremely interesting observation has been made by Pearson *et al.* (1952) in the American bat, *Corynorhinus rafinesquei*. In this species the gestation period varied in different colonies and during the different years when they made their observations. The range was from 56 days to 100 days. Pearson *et al.* (1952) stated, ' Such variability in the length of gestation is most unusual

TABLE 1

GESTATION PERIOD AND OTHER RELEVANT DATA ABOUT SOME INDIAN BATS

Species	Locality	Wt. of adult in gm.	Wt. of young in gm.	No. of young in the litter	Gestation period in days	Pregnancy season
Cynopterus sphinx gangeticus	Nagpur	80-100	12-14	1	115-125	October to July (2 litters)
Rousettus leschenaulti	Aurangabad	50-90	12	1	125	November to July (2 litters)
Pteropus giganteus giganteus	Nagpur	600-900	—	1	140-150	November to April
Megaderma lyra lyra	Nagpur and Aurangabad	40-45	7-8	1	150-160	November to May
Hipposideros fulvus fulvus	Nanded	8-9	2·2	1	155-160	November to May
Hipposideros ater	Nanded	5-7	1-1·2	1	155-160	December to June
Hipposideros bicolor pallidus	Pilani	5-7	1·2	1	40-45	March to May
Pipistrellus ceylonicus chrysothrix	Nanded	7-8	1·2-1·4	2-3	50-55	July to September
Scotophilus wroughtoni	Bangalore	—	—	2	105-115	March to July

TABLE 2

DATA COLLECTED FROM LITERATURE ON THE GESTATION PERIODS IN BATS

Species	Body weight in gm.	Length of gestation	Authority
Pteropus geddiei	450 to 875	5 to 6 months	Baker & Baker ('36)
Rhinopoma kinneari	30 to 35	123 days	Anand Kumar ('65)
Desmodus rotundus murinus	38 to 48·5	Over 5 months	Wimsatt & Trapido ('52)
Myotis lucifugus lucifugus	—	50 to 60 days	Wimsatt ('45)
Pipistrellus pipistrellus	—	44 days	Deanesly & Warwick ('39)
Pipistrellus tralatitius abramus	—	About 70 days	Uchida ('50)
Corynorhinus rafinesquei	7·72 to 8.35	56 to 100 days	Pearson *et al* ('52)
Miniopterus australis	4·5 to 7·9	About 110 days	Baker & Bird ('36)
Tadarida cynocephala	—	77 to 84 days	Sherman ('37)

among mammals and may be associated with varying amounts of torpidity in different years with varying climatic conditions'. They further suggest that the differences in the duration of gestation may be due to variation in the rates of development in the pre-implantation stage because 'development of the embryo is probably more uniform after implantation, when almost all females have a warm body temperature, than in early pregnancy when some females have low body temperatures and others high'. This suggestion implies that delayed implantation of the blastocyst occurs in *Corynorhinus rafinesquei* if the females are in a torpid hibernating condition after fertilization of the ovum, and that the embryo implants immediately after fertilization, if the female maintains normal metabolic level and body temperature. Another bat experiencing delayed implantation is *Eidolon helvum* (Mutere 1965), which, surprisingly, is a tropical fruit-bat from equatorial Africa.

While working on *Desmodus rotundus*, Wimsatt & Trapido (1952) observed, 'Data assembled from the literature suggest that among bats some direct correlation exists between the length of gestation and the size of the animals. It also reveals a tendency for the gestation period to be longer in tropical than in temperate zone species'. However, the data presented in the present paper indicate that the gestation period in bats does not have any relationship to the size of the adult or the size and number of the young delivered, or the geographical location or other ecological factors. Perhaps, the duration of pregnancy in a given species is primarily genetically determined, and only slight variations in gestation length may occur in specific cases due to climatic and physiological factors. It appears that the essential aim is to deliver the young in the most favourable season, and different species of bats have devised different means to accomplish this. The unfavourable seasons like severe winter or very hot summer or the season of incessant rain are avoided for parturition.

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Some rare Aphids in new Regions in India

BY

S. KANAKARAJ DAVID
Madras Christian College, Madras

I. APHIDS NEW TO SOUTHERN INDIA

1. **Sarucallis kahawaluokalani** (Kirkaldy) 1907

Myzocallis kahawaluokalani Kirkaldy 1907.

Tao (1964) assigned this species to the genus *Sarucallis* Shinji on account of the presence of tubercles on the head and abdomen only and the elongate secondary rhinaria on the antennal segments.

In India this species has so far been known only from the north-east region where its food plants are *Lagerstroemia* sp. and *Lawsonia alba* (Ghosh & Raychaudhuri 1959, and Basu 1961). This has now been found in the extreme south in Trivandrum (Kerala) on *Lagerstroemia* sp. (iv. 57) by the writer.

2. **Akkaia bengalensis** Basu 1968

This species was taken in Dodabetta, Ootacamund (2637 m. above sea-level) (coll. A. A. Kareem, 19. vii. 60) in the Nilgiri hills in south India. Its food plant in this locality is *Polygonum sphaerocephalum*.

3. **Matsumuraja capitophoroides** Hille Ris Lambers 1966

Hille Ris Lambers (1966) described *Matsumuraja capitophoroides* from specimens collected on *Rubus* sp. from Murree, Pakistan. He also mentions that it has been noted in the southern slopes of the Himalayas.

This species occurs commonly on *Rubus* sp. on the Nilgiri hills in south India. It has been taken from Coonoor (2200 m. above sea-level) (12.i.57, coll. S. K. David) and Ketti (2500 m. above sea-level) (iii. 67, coll. S. K. David).

4. **Shoutedenia lutea** (van der Goot) 1917

This species is widely distributed in eastern Asia in Japan, Indonesia and Ceylon where its usual host is *Fluggea virosa*. It was noted in north-east India by Basu (1961) on *Boehmeria polystachya*. The present record is from Walayar, Coimbatore, in south India. Its host plant here is *Fluggea virosa* (19.vii.60, coll. S. Jayaraj).

5. **Dactynotus (Uromelan) compositae** (Theobald) 1915

Macrosiphum compositae Theobald sec. Krishnamurthi (1930).

Although Krishnamurthi (1930) recorded an aphid on *Echinops echinata* as *Macrosiphum compositae* Theobald, this species, according to present concepts, has not so far been met with in south India. An aphid collected on Gallardia in Bangalore (11.iii.62, coll. K. K. Nambiar) establishes that it is present here. It has already been noted in north-east India by Basu & Banerjee (1958) on *Calendula*, Cosmos and Zinnia.

II. Aphids new to the central region of north India

1. **Macrosiphum pachysiphon** Hille Ris Lambers 1966

This species was described from specimens collected on *Rubus* sp. in Murree, Pakistan, and on *Rubus lasiocarpus* in Shillong in north-east India. It has now been noted in Mussoorie, Uttar pradesh (2005 m. above sea-level) (22.ix.66, coll. S. K. David) on *Rubus* sp.

This species closely resembles *Sitobion* Mordwilko but has longer and larger number of hairs on the body. Unlike species of *Sitobion* group, these aphids, which were green in colour, were found closely huddled together on the stem of the terminal shoot.

2. **Aphis kurosawai** Takahashi 1921

Brachyunguis kurosawai (Takahashi) sec. Tao 1962.

This species was noted on *Artemisia vulgaris* in Dehra Dun, Uttar Pradesh (681 m. above sea-level) (23.ix.66, coll. S. K. David). It was green in colour and was found on the terminal shoot of the inflorescence which it twisted badly. Ants were present with the aphid.

3. **Longicaudus himalayensis** Hille Ris Lambers 1965

This species was differentiated from other species of the genus by two alate specimens collected on *Quercus* sp. in Simla (x.57, coll. K. K. Nirula) (2205 m. above sea-level) sent by the writer. Three other alates of the same sample are in the writer's collection. Since a description of the species was not given by Dr. D. Hille Ris Lambers, it is included here.

Alate viviparous female.

Body oval, 1·728 to 2·016 mm. in length. Tergum lined with striae of minute spinules in close parallel series transversely all over. Brown sclerotic stripes are present in the spino-pleural portions of abdominal segments II to V, coalescing with each other to form a composite dark patch with perforations in the intersegmental areas. Marginal sclerotic spots are present. Hairs long, thin, pointed, about equal in length to the basal breadth of the antennal segment III. Tergite VIII with 4 hairs.

Head flat, smooth and brown. Hairs on the vertex about $\frac{3}{4}$ basal breadth of antennal segment III. No frontal tubercles. Antenna brown slightly shorter than the body. Segment I smooth with a whorl of about 8 hairs which are short and thick. Segment II smooth with about 4 or 5 hairs. Segment III brown, long and smooth with about 60 to 75 oval, tuberculate rhinaria on all sides and about 13 short, thick hairs, about $\frac{1}{3}$ the breadth of the segment. IV brown, imbricate, about $\frac{1}{3}$ the length of segment III with 0 to 4 rhinaria and 2 or 3 hairs. V brown, imbricate with 3 or 4 hairs. VI base slightly shorter than V, processus terminalis short, about 2 to $2\frac{1}{2}$ times the base of that segment.

Rostrum short, reaching second coxae, last two segments brown and broad; last segment broad at base, equal to its length, with slightly curved sides, tapering to a slightly obtuse apex, about $1\frac{1}{4}$ the length of the 2nd joint of the hind tarsus, with 2 or 3 hairs besides the apical pairs.

Siphunculi light brown, short, about $\frac{1}{16}$ of the body, cylindrical, slightly tapering, with spinule striae all over and without a flange. Cauda light brown, about equal to the length of siphunculi, conical, broad at base, slightly longer than broad, with about 9 hairs. Legs brown, evenly hairy with short thick hairs, some spinule striae in distal ends of femora in the hind leg. First tarsal chaetotaxy 6, 6, 6. Wings normal venation with the stigma elongate and the veins dark.

MEASUREMENTS OF SPECIMENS IN MM.

No.	Length of body	Antennae	Siphunculi	Cauda	Antennal segments III	IV	V	VI		Rhinaria on III	IV
1.	2·016	1·71	·11	·11	·738	·252	·198	·126	+·27	66	0
2.	1·998	1·647	·108	·11	·72	·216	·171	·126	+·288	67	4
3.	1·728	1·71	·114	·108	·738	·234	·198	·126	+·288	73	3

On *Quercus* sp., Simla, x.57, coll. K. K. Nirula. Since all these are only alates, it is doubtful whether *Quercus* sp. is a regular food plant.

4. **Liosomaphis atra** Hille Ris Lambers 1966

Hille Ris Lambers (1966) differentiated this species from other species of the genus by the dark sclerotic tergum of the abdomen. It was noted on *Berberis* sp. in Murree, Pakistan. An aphid collected on this plant in Simla (19.ix.56, coll. A. N. Azad) closely resembles this species in the sclerotic pattern of the abdomen. It has, however, a shorter rostrum reaching only to the middle coxae.

5. **Paratrichosiphum tattakanum** (Takahashi) 1925

This species has so far been recorded in north-east India on *Quercus* sp. by Basu (1961). It has also been taken on the same plant in Simla (ix.57, coll. K. K. Nirula) and Mussoorie (22.ix.66, coll. S. K. David).

6. **Forda (Pentaphis) orientalis** George 1928

Forda orientalis George 1928.
Forda hirsuta Mordwilko sec. David 1958.

This species was described from specimens collected on the roots of *Sorghum vulgare* (syn. *Andropogon sorghum*) in Coimbatore. It was again collected on the roots of *Pennisetum typhoides* in Coimbatore (8.x.55, coll. S. K. David) (David 1958). Dr. D. Hille Ris Lambers in private correspondence, points out that this species differs from *Forda* (*Pentaphis*) *hirsuta* Mordwilko 1918 by the pointed hairs on the body as opposed to the blunt hairs in the latter species.

This species has now been collected on the roots of *Bothriochloa insculpta* in Dehra Dun, Uttar Pradesh (22.ix.66, coll. S. K. David).

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A Bird Count on the Arabian 'Jol'

BY

LESLIE H. BROWN

(*With two plates*)

INTRODUCTION

Quantitative estimates or counts of bird species anywhere in the tropics are sadly lacking. The numbers of species that occur in any area, with some comments on their general abundance (e.g. fairly common, rare, abundant, everywhere, etc.) are usually available. But actual quantitative records of the numbers of individuals of any species present have scarcely ever been made. This makes it extremely difficult to guage the proportion of the avian population dependent upon various available food supplies, such as seeds, fruit, or insects. In other words, to relate the avifauna to its environment.

Bird populations have seldom been counted adequately in temperate regions, much less in the tropics, and still less in such extreme environments as desert. When an opportunity occurred, in October 1965, to make a broad transect count in a large area of the Arabian 'Jol' or desert, between the Wadi Hadhramaut and the Rub al Khali (or Empty Quarter), I therefore seized the chance. The results cannot be claimed as anything more than a broad indication of the relative abundance of the species in this area at this particular time, but are probably better than a mere guess based upon relative abundance of species as reported by collectors, or as indicated by the number of skins available in museums.

The count took place between 7/x and 12/x/65, along a route from Armaa—Sanau—Wadi Rakhot—Tarfait—Armaa—Fort Thamud—to the head of Wadi Ardha (one of the tributary *wadis* of the Wadi Hadhramaut). The distance covered was 413 miles as recorded on the milometer. In this distance a total of 676 birds of at least 20 species were seen in a transect estimated to total about 6820 acres, or 10·6 sq. miles. This results in an overall density, actually probably higher, of one bird per about ten acres in all types of habitat. This very approximate figure is qualified by the observations which follow.

METHODS

The count was made from an open-sided Landrover travelling along rough desert tracks, usually at 5-15 m.p.h. but sometimes up to 25 m.p.h.

for short distances. As birds were flushed by the passage of the vehicle they were identified and recorded in a field notebook ; the records were summarised and recorded more clearly at the end of each journey, usually twice a day.

For the purpose of the count I estimated that a strip of land 20 yards wide on either side of the track was being covered. Most birds within this distance were either flushed into flight, or ran and showed themselves, particularly in bare terrain. Beyond this distance they frequently squatted without flying, and in thick vegetation could not be seen. One mile of track was in this way estimated to represent a transect of about 16·5 acres area.

The terrain was divided into three types of habitat called, for convenience, Stony Jol, Earth Jol, and Wadi Beds. Generally the track traversed one or other of these habitats for several consecutive miles but sometimes, particularly in Wadi Beds, it would follow the boundary between one type and another. In such cases arbitrary decisions had to be made as to the habitat to which a particular bird belonged. In practice this was not difficult, for observations on foot and at camping sites showed that birds of the Stony and Earth Jol were also to be found in Wadi Beds, though not usually vice-versa.

Identification of species was made at the time when possible, and by later reference to Meinertzhagen's BIRDS OF ARABIA (1954). It was not possible to identify all the birds seen at once, but the total number of species was small and several, such as the Bifasciated Lark *Certhilauda alaudipes*, Blackstart *Cercomela melanura*, Houbara *Chlamydotis undulata* and Seesee Partridge *Ammoperdix heyi* were instantly recognisable. No attempt was made to separate several similar species of larks seen in the open and grouped together as ' Larks, various ' as this could not always be done from a moving vehicle ; 66% were probably *Ammomanes deserti*. The unidentified species were mostly small skulking warblers noted in the bushes in the Wadi Beds, and not identifiable at all from a moving vehicle.

The species have been listed in the order of Meinertzhagen's, BIRDS OF ARABIA. While not agreeing with much of the author's systematic approach it seems preferable to adhere to the order given in the only available standard work on Arabian birds than to make confusion worse confounded by utilising e.g. the order of the Peter's List (in process of revision) or Sclater's SYSTEMA AVIA AETHIOPICARUM, which properly deals with areas outside the limits covered by this survey.

Ecology of the area

As stated, the area was divided into 3 main habitats:

(i) **Stony Jol.** Forbidding country composed of vast expanses of limestone chips, gravel, or larger plate-like stones, and practically devoid of vegetation. Generally dark brown in colour and, to superficial examination, markedly hotter than the other two types.

(ii) **Earth Jol.** Open treeless desert, but composed of earth or soil rather than stones. Yellowish-brown in colour, with somewhat lower surface temperatures, but still very hot in the middle of the day. Vegetation, while still very sparse, was more abundant than on Stony Jol, and included small patches of dried annual grasses and a few lowly succulents.

(iii) **Wadi Beds.** The bottoms of depressions, or actual water-courses, small or large. In such areas quite a good cover of shrubs and perennial grasses was usual. Shrubby *Acacia* bushes, of species close to *A. mellifera*, *A. nubica* and *A. reficiens* were commonest, but with some *Salvadora persica* and occasional larger trees, including *Boscia* sp. The grass was often knee-deep, but grey and dry. This type of terrain provides the only shade available, other than in the shelter of a rock, and while no measurements were possible the temperature of the soil in such shade was certainly much lower than in the two preceding habitats.

The vegetation in the Wadi Beds was surprisingly luxuriant considering that the whole region has annual rainfall of the order of 2-3 inches (50-75 mm.) and that rain sometimes does not fall at all in particular years. This is probably the result of differential absorbtion of the available rainfall. In the occasional torrential storms heavy enough to result in runoff the Stony Jol loses most of the water that falls on it, so that its effective annual rainfall may be no more than half the average annual total. Percolation and absorbtion would be better on the Earth Jol, but under heavy rain this becomes impacted and runoff occurs. The runoff from both these upland areas collects in the Wadi Beds, where it either rushes along as a torrent or, in flat areas, lies there as a shallow sheet of water till it sinks in or evaporates. The effective rainfall per unit area of Wadi Bed may be 5-6 times the annual average for the whole region, perhaps as much as 10-15" (250-375 mm.). It is this that permits the development of relatively luxuriant vegetation in the Wadi Beds.

No quantitative estimate of the proportion of the country covered by each of these types of habitat was possible. The transect passed through 119 miles (29%) of Stony Jol, 205 miles (50%) of Earth Jol, and 89 miles (21%) of Wadi Beds. However, the road tended to follow Earth Jol where it could, or wound up Wadi Beds between forbidding stony hills—the best and most practicable route. In practice it was likely that Wadi Beds formed no more than 10-15% of the total area, the remainder being divided between Earth Jol and Stony Jol in perhaps the proportions 35% and 50-55% respectively. Stony Jol was certainly the most widespread habitat.

Bird count results

Details of the actual counts are given below, with mileages and the time of day (Table 1).

TABLE 1

	Date	Route	Time	Mileage	No of Birds	Notes
1.	7/x	Armaa-Sanau	14·00-18·30	57	179	Incl. large flock of Sandgrouse.
2.	8/x	Sanau—Camp in desert	11·30-13·00 and 14·30-17·00	75	89	
3.	9/x	Camp—Wadi Rakhot	08·00-08·30	4	20	
4.	10/x	Wadi Rakhot-Camp Camp—Tarfait	15·30-17·30 07·00-10·00	80	94	
5.	10/x	Tarfait-Armaa	14·00-17·00	56	125	
6.	11/x	Armaa-Thamud	16·00-18·00	46	78	Completed after dark.
7.	12/x	Thamud-Wadi Ardha	14·00-18·30	95	91	
				413	676	

Overall average of birds per mile of transect (16·5 acres)=1·63, or about 1 per 10 acres.

The several counts can be analysed further from several points of view, as follows:

(i) *Effect of Time of Day.* The time of day had an effect on the numbers of birds seen. In this area, at this time of year, first light was about 04·45 hrs. and birds were stirring immediately afterwards. An Egyptian Vulture was seen to leave its roost near Sanau by 05·00 hrs. on 8/x and Chestnut-bellied Sandgrouse *Pterocles exustus* were flighting to water by 05.40 hrs. The 'early morning' occupied until about 07·00 hrs. after which the heat of the sun was noticeable, though not strong until *c.* 09·00 hrs. Thus, between 05·00 and 09·00 hrs. was a time of maximum activity for birds, reduced thereafter as the day's heat increased.

The hottest hours were between 11·00 and 15·00, with a slight but noticeable cooling after 14·00 hrs. We tried to move least during this hot period but sometimes were forced to. After 15·00 hrs. activity among birds increased, but was never as great as in the cool early morning. Some birds, however, particularly flocks of larks, were then to be seen making for roosting sites.

Although dusk did not come before 18·30 hrs., and it was not properly dark until later, few birds were on the move after 18·00 hrs., when daylight was still strong. There was, in fact, much more intense bird activity in the first hour of daylight (05·00-06·00) than in the last (17·30-18·30), and in the first four hours of daylight than in the last four, Counts 1, 3, 4, and 6, totalling 187 miles were considered as having been done at favourable times of day, when birds were on the move, and counts 2, 5, and 7, totalling 226 miles, at less favourable or unfavourable times. The first group of counts averaged 2·0 birds / mile overall, or about one per eight acres. The second averaged 1·3 birds / mile overall, or about 1/13 acres. It is likely that only the counts done at favourable times of day, when most birds in the 40 yard wide transect moved or were flushed, gave a good approximation of the numbers. One bird per eight acres overall is accordingly a better estimate than one bird per ten acres overall, or one per thirteen acres.

Individual habitats at favourable times gave still higher figures. On 9/x in four miles of Wadi Bed between 08·00 and 08·30 hrs. (probably just past the peak of morning activity) 20 birds, or five per mile, or one per 3·5 acres were seen. This particular stretch of Wadi Bed was, moreover, not abnormally rich in birds, so that such areas probably support an average at least a bird per four acres.

I made several attempts to check the accuracy of the transect counts by trying to count small areas near our camps on foot. However, I found the birds so shy and elusive that I obtained negative results. Evidently, counts from a car, inaccurate though they may be, are more reliable than those done on foot, when larks and partridges scuttled away unseen among the vegetation and birds that took flight more readily usually flitted from bush to bush before they could be identified.

(ii) *Effect of Habitat.* As might be expected, the denser the vegetation the more the birds, both in number of species and individuals. Results according to habitat are set out in Table 2.

From this it can be seen that the average overall density for Stony Jol was almost exactly one bird per mile, or one per 16·5 acres. For Earth Jol the overall density was 1·48 per mile or one to 11 acres, and for Wadi Beds three per mile or one per 5·5 acres.

The figures for Stony Jol are probably about right. On several occasions birds seen included Ravens, *Corvus corax ruficollis* or Egyptian Vultures which perched or loafed there although actually attracted to camp sites. We avoided travelling through Stony Jol in the heat of the day so that the counts are less biased by the effect of time of day. In Earth Jol and Wadi Beds we did more travelling in the hot hours, and the overall density figures should be somewhat higher. Perhaps densities of 1/15 acres, 1/8 acres, and 1/4 acres would be near the truth for the three habitats.

Figures for overall density in these habitats in a single isolated count may mean little, and would evidently have to be supported by other figures over a period of time for any true picture to emerge. However, the figures for relative numbers of particular species are probably more closely indicative of the relative abundance and habitat preferences of certain species. Since over 50% of the species are apparently resident the sample may give quite a good idea of the relative numbers.

TABLE 2

NUMBERS OF INDIVIDUAL SPECIES SEEN IN DIFFERENT HABITATS

Species	Status	Stony Jol 119 miles	Earth Jol 205 miles	Wadi beds 89 miles	Total 413 miles
Corvus corax ruficollis	R	13	3	2	18
Certhilauda alaudipes	R	—	21	—	21
Eremopterix nigriceps	R	—	15	—	15
All other larks (3+spp.) including	R and M	81	95	54	230
Ammomanes deserti (66%)	R	54	63	36	153
Lanius excubitor	R	—	1	8	9
Pycnonotus capensis	R	—	—	3	3
Turdoides squamiceps	R	—	—	20	20
Oenanthe deserti	M	8	14	4	26
Oenanthe leucomela	M	—	2	5	7
Cercomela melanura	R	5	—	20	25
Hirundo domestica	M	—	2	—	2
Merops superciliosus	M	—	—	6	6
Falco tinnunculus	M	1	—	—	1
Buteo rufinus	M	1	—	—	1
Neophron percnopterus	M	2	11	3	16
Pterocles exustus	R	—	118+	30	148+
Chlamydotis undulata	R	—	—	1	1
Ammoperdix heyi	R	1	2	68	71
Unidentified (mainly small warblers, 4-5 species).	R and M	2	16	38	56
Total		114	300	262	676
Number of sp. minimum		12	14	16	20
probable		13	16	10	25
Species not seen in other habitats		2	3	4	

Notes (1) Of two species found only in Stony Jol (Kestrel and Buzzard) both were probably fortuitous; of three found in Earth Jol one (Swallow) was fortuitous; but all four species found only in Wadi Beds are confined to that habitat.

(2) The number of species of unidentified small warblers was greater in the thick cover of Wadi Beds than in Stony Jol, where few were seen.

(3) Under Status, R=Resident, M=Migrant.

Some species appeared very clearly confined to or concentrated in certain habitats. The Bifasciated Lark, for instance, was never seen away from Earth Jol, and actually the population was entirely concentrated in a relatively small part of the area traversed, between Armaa-Sanau and Armaa-Thamud. In this area, which was also heavily populated by large *Uromastix* lizards (vern. *Dhabb*) detailed ecological and pedological investigation would doubtless have revealed some consistent feature accounting for this restricted distribution. The Finch-Lark also appeared to prefer Earth Jol, but may not have been confined to it, as some were probably included among the larks, various, which would not apply to the instantly identifiable Bifasciated Lark. The Blackstart and Seesee Partridge, although not absolutely confined to the denser vegetation of Wadi Beds, were as characteristic of that habitat as the babbler *Turdoides squamiceps* or the bulbul *Pycnonotus barbatus*, both species seen nowhere else.

In contrast to these species were several, for instance the Egyptian Vulture, Long-legged Buzzard, and Kestrel which could have been encountered anywhere, though the last two are perhaps more likely to be seen in rocky mountainous areas. Equally the fact that Swallows were only seen in Earth Jol is entirely fortuitous ; they would have been more likely in Wadi Beds. Ravens might also have turned up anywhere, but in practice showed a definite preference for rocky terrain.

In relative numbers larks are by far the commonest birds in the area. The total for all larks is 266/676, or 39·5% of all recorded birds. Apart from the easily identifiable Bifasciated and Finch Larks probably about 66% of Larks, various, were the Desert Lark, *Ammomanes deserti*, which, with a total population of about 153 in the sample was the commonest and most widespread bird in the area, living in all habitats, and the only species at all common on Stony Jol. Other larks included with it in Larks, various, probably included the Crested Lark *Galerida cristata* and other species of *Ammomanes* with, for instance, Finch Larks when seen against the light, when they could not be so certainly identified. With greater experience it became possible to distinguish the individual species more clearly, but as it had been found impracticable to do so in the first one or two days the several rather similar-looking species of larks were lumped together to the end.

The second commonest species was the Chestnutbellied Sandgrouse, but this may have been fortuitous, as we camped near a well-known watering place at Sanau, and observed the flight next morning. If that flight had been included in the count the sandgrouse would have outnumbered by far all other species together. Perhaps 3000-4000 collected near the spring, but they may have come from an area as great as 5000 square miles. Their real density may have been lower, about 100 : 200 acres, than is indicated by the count which gives them an overall density of one per 2·8 miles of transect, or 45 acres. But the numbers coming to the spring and the distance they may have come from could not be accurately computed.

Other than larks and sandgrouse the commonest species, rather surprisingly, was the Seesee Partridge. It was confined to well-vegetated areas. Other characteristic birds seen every day included the Desert Wheatear, seen in most types of habitats, the Blackstart and the Babbler, seen mainly or entirely in Wadi Beds. It was something of a surprise to find such species as the Great Grey Shrike *Lanius excubitor* relatively rare in total numbers as, being conspicuous, they were more noticeable than several commoner species.

Probably the six commonest and most widespread birds of the area are the Desert Lark, perhaps another species of Lark, the Chestnut-bellied Sandgrouse, Seesee Partridge, Desert Wheatear, and Blackstart, in approximately that order of abundance.

Notes on Individual Species

The list of species given in Table 2 contains some surprising gaps. For instance, no species of dove was seen, nor any courser. There were apparently no resident raptors at all, either diurnal or nocturnal, and very few migrants (1 Kestrel and 1 Buzzard), other than the scavenging Egyptian Vulture, which is largely dependent on man. No harrier of any species was seen in what should have been the height of their southward migration.

The absence of diurnal resident raptors was peculiar in that populations of such species as Seesee Partridges and Chestnutbellied Sandgrouse, with large and small lizards (*Uromastix* and other species) appeared more than adequate in some areas to support occasional pairs of, for instance Lanner Falcons *Falco biarmicus* or Chanting Goshawks *Melierax metabates*, both of which would occur in a country with similar vegetation in northern Kenya. The total absence of nocturnal raptors was perhaps stranger still. No owl of any species was either seen or heard at any of several desert camps, and only one nightjar, probably a migrant *Caprimulgus europaeus* was seen near an oil company camp, catching insects by the electric lights. According to my companion, Mr. G. H. H. Brown, an experienced field naturalist who has spent many years in the deserts of northern Kenya, this absence of diurnal and nocturnal raptors was normal. In several months, residence in this area he had seen only odd large falcons, probably Sakers *Falco cherrug*; and had once heard a Scops Owl *Otus scops*.

The one trace we found of a resident raptor was a breeding site found on 10 October between Wadi Rakhot and Tarfait, in a pass among stony hills. There were two large nests, both on top of *Boscia* trees, broad flat structures resembling those of the Lappetfaced Vulture *Torgos tracheliotus* or the Whiteheaded Vulture *Trigonoceps occipitalis*, neither of which has been recorded breeding in Arabia, though the Lappetfaced Vulture has bred in the Rift Valley near the Dead Sea. They might also have been nests of the Tawny Eagle *Aquila rapax*. There was evidence that the nests had been occupied recently, one in 1965, but there were no feathers to assist identification. All I could find was a few pieces of bone, not identifiable later, but probably picked up as carrion. It is unlikely that any naturalist will pass that way for some time, but the identity of the two nests could be checked in spring during the breeding season; neither is more than 300 yards from the road, which passes just beside one of them.

Apart from these general observations the following are notes on species of particular interest:

Corvus corax ruficollis Brown-necked Raven.

A scavenger about human encampments, sometimes met with in open desert. Showed a definite preference for perching on black or dark rocky outcrops, avoiding the pale coloured Earth Jol. Probably the most widespread resident scavenging species.

Certhilauda alaudipes Bifasciated Lark.

A characteristic rather than an abundant species of certain types of Earth Jol. All those seen were noted in about 110 miles of the total of 205 miles of this type of country traversed. They appeared to avoid the more extreme forms of desert and to prefer areas with at least access to perennial grass and shrubs in the depressions and Wadi Beds, though they themselves were never seen except on areas of bare earth. They occurred singly or in pairs, never in flocks.

Ammomanes deserti Desert Lark.

The commonest and most widespread species in all habitats, and the only species at all common in the more extreme environments of the Stony Jol. Since they were inconspicuous ground-loving birds (unlike *C. alaudipes*) a good many were probably missed. Usually they occurred in pairs, sometimes singly, and towards evening sometimes in small flocks, apparently making for cover to roost.

Eremopterix nigriceps Finch-Lark.

Seen only a few times, in small flocks, so that it appears from figures to be more widespread than it actually is. A proportion of the unidentified larks, seen in poor light, were probably this species. It showed a definite preference for Earth Jol, but probably also occurred on Stony Jol.

Oenanthe deserti and **Oenanthe leucomela** Desert Wheatear and Pleschanka's Chat (or Pied Wheatear).

These two species of wheatears showed clear preferences for different habitats. The pale-coloured Desert Wheatear preferred open habitats of Stony or Earth Jol, occasionally perching in Wadi Beds, while the Pied Wheatear preferred denser vegetation with excursions into the Earth Jol, never in Stony Jol.

Cercomela melanura Blackstart.

Common in Wadi Beds, and sometimes seen out in the open in Stony Jol where such areas adjoined Wadi Beds. It appeared to avoid Earth Jol, perhaps because, as a dark-coloured bird, it would have been relatively conspicuous against a pale-coloured background. However, in the absence of any relentless diurnal avian predator it is a little difficult to see how such preference could be of any practical value ; perhaps it is during seasons of migration when more raptors may be present.

Buteo rufinus Longlegged Buzzard.

One individual, of the dark phase, was seen late one evening, in Stony Jol. It was shy and difficult to approach, but with x 12 binoculars the field characters were clear.

Neophron percnopterus Egyptian Vulture.

Seen migrating across our track in flocks, and also around dwellings and camps. No evidence of breeding was seen, so that probably all individuals present were migrants.

Pterocles exustus Small Pintailed or Chestnutbellied Sandgrouse.

At a spring near Sanau the sandgrouse flight was observed from before first light to about 09·00 hrs. There was no evidence that any sandgrouse got on the wing before dawn, and the first approaching parties, coming from close by, were seen at 05·40 hrs. about 1 hour after first light. Small parties kept coming upto 06·30, after which the flight intensified, with parties both larger and more frequent. The main flight came in at 07·00-07·30 hrs. I attempted to count the incoming birds at first, but the impossibility of watching all round the compass, and the numbers, defeated me. All first collected at a gathering ground about half a mile from the spring, on some stony ridges, where they had a good view all round. By 08·00 hrs. flighting had stopped but the birds had made no attempt to drink. There may have been 3000-4000 present by then, and assuming that all had started to flight soon after first light (as the parties coming from close by did) they may have come from anywhere within a range of 40-50 miles, perhaps more. They may therefore have collected at the spring from a total of some 5000 square miles of country. We left before they had gone to water, but perhaps they would have remained on the gathering ground as long as any human beings were obvious in the area.

Chlamydotis undulata MacQueen's Bustard, or Houbara.

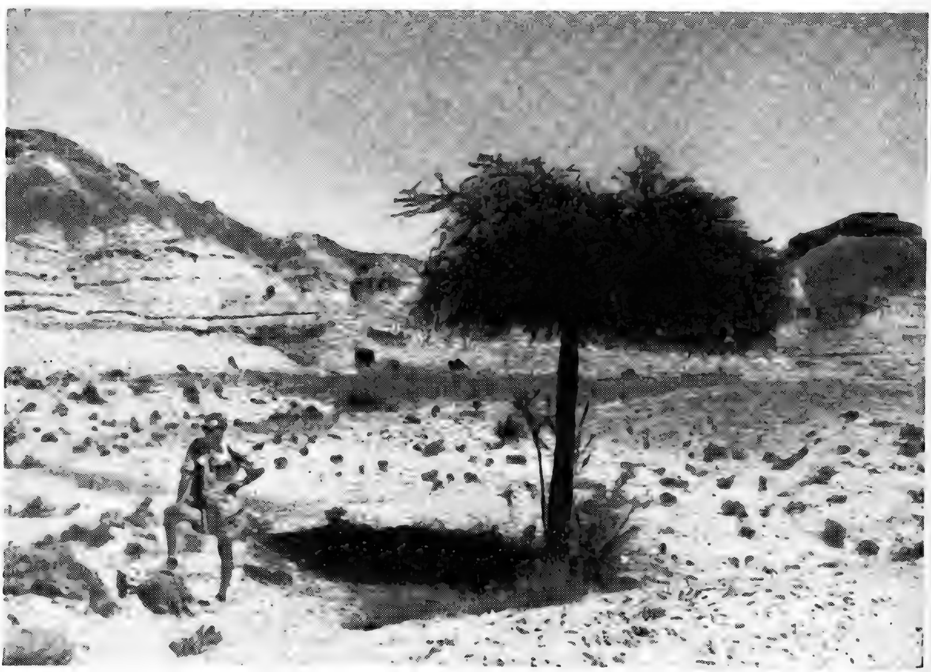
Only one was seen, but this was said to be unusual. This species is hunted by the local tribesmen with rifles.

Leslie Brown: Bird Count

Above : Stony Jol, in the headwaters of a tributary of the Wadi Hadhramaut ; almost bare of vegetation. Haunt of *Ammomanes deserti*. *Below :* Earth Jol with surface of small gravel in foreground ; Wadi bed vegetation in a depression behind ; haunt of *Certhilauda alaudipes*.

(*Photos : Author*)

Leslie Brown : Bird Count



Above : Wadi bed vegetation in the same depression with perennial grasses and shrubs ; haunt of *Cercomela melanura, Ammoperdix heyi* etc. *Below : Boscia* tree in stony desert near Tarfait, with unknown raptor's nest on top. The figure is 6′ 4″ tall.

(*Photos : Author*)

Ammoperdix heyi Seesee Partridge.

Found in pairs, or in small coveys of up to 10, in all Wadi Beds. Not apparently hunted by the local Bedu at all.

Summary

1. An account is given of the birds counted in a road transect of 413 miles between 7 and 12, October 65, in an area of the Arabian Desert between the Wadi Hadhramaut and the Empty Quarter.
2. The ecology of the area is described. It is broadly divided into 10-15% Wadi Beds with perennial grass and shrubs, 35% Earth Jol with bare soil and sparse vegetation, and 50-55% Stony Jol composed of brown limestone chips and slabs. Birds are most numerous and varied in the Wadi Beds (20 spp. as cf. 12 in Stony Jol).
3. The numbers seen, and the factors affecting these, are discussed. The overall average recorded is one bird/10 acres, varying from 1/16·5 acres in Stony Jol to 1/5·5 acres in Wadi Beds. Higher figures were recorded in the cooler hours of the day in well vegetated areas. More realistic figures might be 1/15 acres, 1/10 acres, and 1/4 acres for Stony Jol, Earth Jol, and Wadi Beds respectively.
4. Numbers of individual species seen are given. Larks are by far the commonest birds, totalling 266 in 676 seen. *Ammomanes deserti* is the commonest and most widespread species, followed by *Pterocles exustus*, *Ammoperdix heyi*, *Oenanthe deserti* and *Cercomela melanura*. Notable absentees included resident diurnal and nocturnal raptors, coursers, and doves.
5. More detailed field notes are given for *Certhilauda alaudipes*, *Ammomanes deserti*, *Eremopterix nigriceps*, *Oenanthe deserti* and *O. leucomela*, *Cercomela melanura*, *Buteo rufinus*, *Neophron percnopterus*, *Pterocles exustus*, *Chlamydotis undulata*, and *Ammoperdix heyi*. It is thought that 3000-4000 *P. exustus* collected at one spring from perhaps 5000 square miles of terrain.

Pearl Fisheries of the Gulf of Kutch

BY

C. R. EASWARAN, K. R. NARAYANAN AND M. S. MICHAEL
Fisheries Research Station, Govt. of Gujarat, Jamnagar

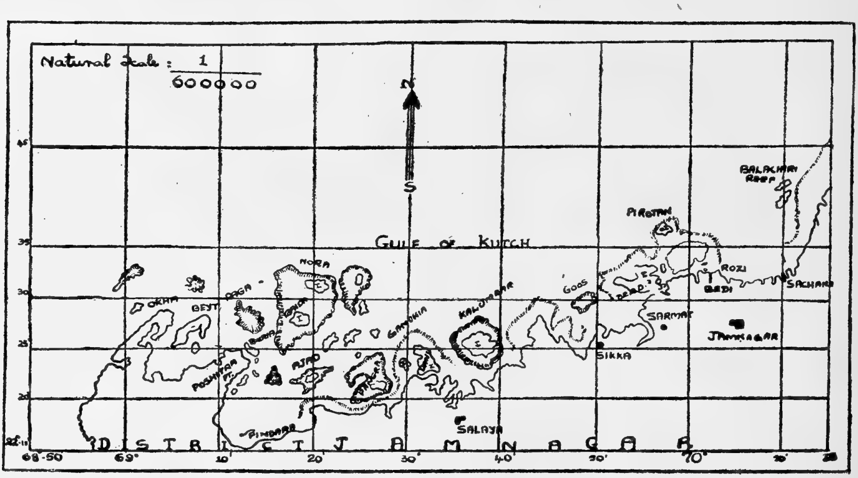
(*With three text-figures*)

INTRODUCTION

Pearl Fisheries, in the Gulf of Mannar, have been studied at length by many workers, but information on the age-old fisheries of the Gulf of Kutch is very scanty. Hornell (1909) mentions the rich pearl oyster reefs that are scattered along the coastline of the princely State of Nawanagar and gives certain salient features of the pearl fishery of that State. Later, Gokhale, Easwaran & Narasimhan (1954) reviewed the pearl fisheries conducted by the then United States of Saurashtra in 1953. The works of Gokhale (1963), Narayanan, and Michael (1968) are the only additional information available. The authors, therefore, have attempted in the present work to enumerate the resources and the main features of the pearl fisheries of the Gulf of Kutch.

PEARL OYSTER REEFS

The pearl oyster reefs of the Gulf of Kutch—locally known as *Khaddas*—are scattered all along the southern coast, bordering the coastline of the Jamnagar District. There are about 42 important reefs



covering an area of 60,000 acres, from Jodiya (22° 42′ N., 70° 16′ E.) in the east and Ajad (22° 23′ N. 69° 20′ E.) in the west.

These reefs are not continuous but separated by sandy patches, mudflats and mangrove forests. A typical bed consists of a hard bottom of coral and rocky frame work, with an admixture of mud and sand. The important fauna of these beds are octopi, chanks, *Pinna* sp., globe fishes, mullets, rock perches, crabs, anemones, sea fans, sea lilies, tube dwelling polychaetes, brittle stars and sponges, while *Sargassum* and *Ulva* etc. form the common flora.

The Gulf of Kutch pearl oysters are of the species, *Pinctada fucata* (Gould) (=*Margaritifera vulgaris* Schumacher).

Pearl Fishery

The pearl fisheries have been a State monopoly from time immemorial and are conducted once in three years. The fishery which lasts for three months starts just after the onset of the monsoon, which synchronises with the highest spring tides. Since the reefs are exposed during ebb tides, the fishermen enter the reefs and pick the oysters. These oysters are opened at the end of the camp by the fishermen, in the presence of the officials of the Fisheries Department and pearls removed.

Remuneration to the fishermen varied from time to time. Hornell (1909) reports that the fishermen received 1/8th of the value of the pearls in cash, 1/40th in cloth and 1/20th in food. In addition, two prizes were given to the two villages producing the most valuable collection of pearls. Later, the remuneration system was changed and the fishermen used to get 25% of the value of the pearls realised from the oysters collected by them. Since the fishermen were not satisfied with this system of payment, as their income depended, to a great extent, on luck, it was decided to pay Rs. 0.25 for every oyster collected by the fishermen, irrespective of whether the oyster contained pearls or not. This system is in vogue even today.

Review of the Pearl Fisheries

The pearl fishery of the Gulf of Kutch is quite small in magnitude, compared to that of Ceylon and Tuticorin. While the pearl oyster yield at Tuticorin and Ceylon in a fishery is to the tune of crores, it is only 30,000 on an average per fishery in the Gulf of Kutch. The maximum number of oysters harvested was 76,685 in 1916-17 and the minimum of 522 oysters in 1938-39. The details of the fisheries conducted since 1913 are incorporated in Table 1.

As seen from Table 1, the fishery had been either annual or bi-annual between 1913 and 1938. After 1938, there has been a gap of 3 to 5 years between every fishery. This step of increasing the gap between two consecutive fisheries has not improved the yield of oysters per fishery.

However, it appears that the Gulf of Kutch pearls are costlier and their pearl yielding capacity is more than those of the Gulf of Mannar. This is evident from the fact that while the value of 1000 oysters is only Rs. 25 in Tuticorin and Rs. 22 in Ceylon, it is about Rs. 250 in the Gulf of Kutch.

Unproductiveness and thinner population of oysters have been the main problems facing the pearl fisheries of the Gulf of Kutch. These handicaps are not peculiar to this area as uncertainty and irregularity in the oyster yield have been features of the pearl fisheries of the Gulf of Mannar also. Pearson (1927) records that in Ceylon, there were only 33

TABLE 1

Year	Number of oysters harvested	Value of pearl realised in rupees
1913-14	33,171	7,503·00
1914-15	39,589	15,606·00
1916-17	76,658	14,550·00
1917-18	27,685	7,995·00
1919-20	29,951	14,487·00
1920-21	52,306	10,384·00
1921-22	17,526	6,208·00
1923-24	25,434	15,739·00
1926-27	33,816	28,320·00
1928-29	14,995	15,944·00
1930-31	38,527	10,470·00
1931-32	20,829	6,958·00
1934-35	34,326	12,489·00
1935-36*	9,685	2,344·00
1937-38	44,655	5,360·00
1938-39*	522	135·00
1943-44	37,321	61,693·00
1946-47	31,059	23,531·00
1950-51	32,441	23,000·00
1953-54†	11,519	13,530·00
1956-57	35,389	6,201·00
1960-61	3,922	6,005·00
1961-62	17,208	
1964-65	1,661	..
1966-67	30,000	..

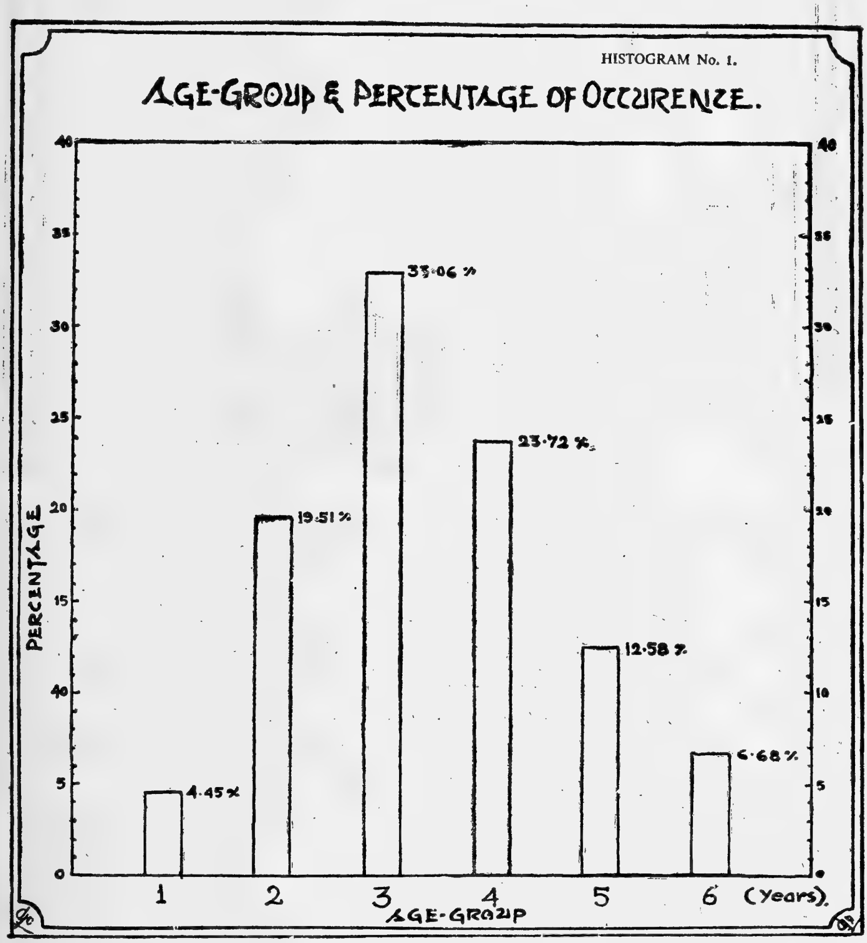
* One camp only † Six camps

fisheries during the 19th century. On the other hand, there have been 23 fisheries in the course of the last fifty years in the Gulf of Kutch, but the yield of the oysters was comparatively very low.

SURVEY AND STUDIES

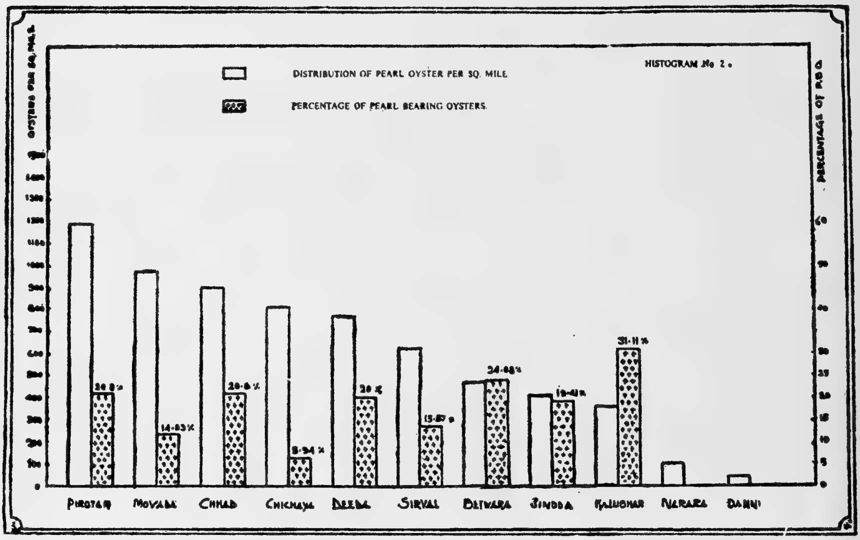
In order to estimate the stock of pearl oysters in the Gulf of Kutch, a random survey was conducted by the authors in 1964. An area of 3 sq. miles was surveyed at the rate of a quarter sq. mile each from twelve oyster beds in twelve days. 1661 oysters were collected from these grounds. On an average, a sq. mile of oyster bed yielded 552 oysters, the maximum being 992 oysters from Pirotan Island.

As shown in Histogram 1, three year old oysters dominated the stock (33·06%) followed by four year group (23·72%) and two year group (19·51%). The five year old oysters formed only 12·58% while the oysters above five years were only 6·68%. The percentage of oysters of one year age and below were quite low (4·45%).



As shown in Histogram 2, the percentage of the pearl bearing oysters is 18·47 on an average, the maximum being 31·11% from Kalumbar Reef and none from Narara and Danni. However, few oysters were collected from Kalumbar Reef.

The beds at Pirotan, Movada, Chhad, Chicheya, Deeda and Sirwal appeared to be comparatively more productive than Betwara, Jindhda, Kalumbar, Narara and Danni, which were quite productive a decade and a half ago. Even in the richer beds the distribution of oysters was scanty. The oysters were not in groups or clusters, but were seen as single individuals widely separated from each other unlike in the 'Paars' of the Gulf of Mannar.



The mangrove forests, which are noted for their sand binding powers have been indiscriminately removed from the oyster reefs. (The stems are used for fuel and the leaves for fodder). This might have resulted in the siltage and deposition of sand in the oyster reefs. Also the very heavy currents of the Gulf have deposited sand on the oyster beds. In fact, Movada, Danni and Kalumbar Reef, which were quite productive a few decades ago, have since been covered with sand to a very great extent. Similar instances have been reported by Pearson (1927) that a large bed of oysters in Ceylon was lost in 1925, due to the action of sand.

With a view to study the causes of this comparatively thinner population and unproductiveness of the oysters, studies on the breeding habits of the oysters were undertaken by the authors.

About 600 oysters collected from the beds were reared in an enclosure in the littoral zone of Sikka coast and in a sea water tank at Sikka. In the former, wooden cages, measuring 3 ft.×3 ft.×6 in. with cubicles and wire gauze windows were used for keeping the live oysters, while in the latter metallic cages measuring 18 in.×12 in.×4 in., suspended from bamboo rafts were used. The growth rate and the gonadial changes in these oysters were observed periodically for two years. The oysters reared in the metallic cages were healthier and grew faster than the oysters confined in the wooden cubicles and those found in the natural beds. The gonads were mature and oozing twice in a year, between October and December and March and May. This indicates that the oysters breed twice in a year. But there were no indications of any spat fall during these periods, for the cultch (metallic cages, bamboos, sea shells etc.) provided for this purpose in the area did not show any attachment of spats. Further, the plankton collected from these localities during these periods did not show the presence of oyster larvae or post-larval spats. Even in the natural beds, the authors failed to observe spats in large numbers except some stray cases here and there.

Devanesan & Chidambaram (1956) have commented that the proximity of the two sexes is essential for the oysters to spawn. Only when the oysters live in dense patches would the chances of spawning be greater resulting in abundant spat-fall. If the females are separated far apart from the males, the ova-shed may not reach the males to furnish them with stimulus to throw out the milt. If this were true, the chances of reproduction in the case of the Gulf of Kutch oysters is little, since the individual oysters are far apart from each other.

The authors have observed that the sexes of the oysters collected at random from the beds were not proportional. Sometimes, they were either exclusively males or females. The period of maturity of females rarely synchronised with that of males. This also may be a factor which has contributed towards the thinner population of the oysters.

According to Hornell (1922), the pelagic life of the pearl oyster larvae is 5 to 7 days, during which time, they are at the mercy of the tides and currents. In the Gulf of Kutch, the tidal levels fluctuate very greatly in the littoral zone where the oyster beds are located. It is, therefore, very likely that the larvae when formed are either destroyed during the low tides, when the reefs become exposed, or carried away by the outgoing tides to the deeper waters, where they may settle if the substrata are suitable, or perish. This is evident from the fact that the spat-fall in the vicinity of the pearl oyster beds in the Gulf of Kutch is very thin if not absent.

Hornell (1916) believed that the oysters found in the shallow waters are the stock from which the spats migrate towards deeper waters. It is quite probable that the oysters that are found scattered in the littoral zone of the Gulf of Kutch are the stock formed by stray spat-falls and the main stock is somewhere in the deeper waters. In that case, it is likely that the deeper waters of the Gulf of Kutch should have rich stock of pearl oysters. A survey of the deeper waters of the Gulf of Kutch by employing expert divers and by dredging have been proposed to the Government of Gujarat by the authors. It is hoped that the results of the survey would throw more light on the pearl fisheries of the Gulf of Kutch.

Acknowledgements

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Food-habits of water-birds of the Sundarban, 24-Parganas District, West Bengal, India

BY

AJIT KUMAR MUKHERJEE

Zoologist, Zoological Survey of India, Calcutta

(*With two text-figures*)

INTRODUCTION

The valuable services of birds specially in checking the undesirable multiplication of certain injurious insects and acting as agents for pollination and seed dispersal, is known. It is also known that considerable damage to crops, fishes, poultry, etc., is done by different species of birds. It is, therefore, very essential that a proper assessment of the benefit or damage done by birds to agriculture and fisheries and the role they play in the realm of nature should form an important item in our scientific programme.

Much progress has already been made on the economic role of birds in Europe and America, notably in Hungary, Great Britain, Soviet Union and the United States of America. However, it is a matter of regret that the information available on the food-habits of birds of the Indian subcontinent is meagre. Jerdon (1862) in his BIRDS OF INDIA made a significant contribution to the knowledge on the habits, including the food-habits of birds. The only work of importance, which can be mentioned as a great event in the history of economic ornithology in this country is that of Mason & Maxwell-Lefroy (1912). Their monographic work contains analysis of food of 110 species of birds based on 1325 stomach contents collected at Pusa (Bihar). It added valuable information to the knowledge of the role of birds in agriculture and their economic importance. The next work of significance is that of Baker (1922-1929), who summarized the information then available on the nature of food of most of the Indian birds. Some recent studies on the food-habits of some species of birds of the Indian region are by Husain & Bhalia (1937, 1939), Bates (1943), Ridley (1954), Bump *et al* (1961, 1964), Christensen (1961, 1964), Mukherjee (1963), Abdulali (1964). Samuel (1949) recorded the Indian House Sparrow as a serious pest of orchard and wheat in Baluchistan (W. Pakistan). Faruqui *et al* (1957, 1960) studied the seasonal food of three species of game-birds found in both West Pakistan and India. Mention may also be made of the work of Brown (1928) on the economic value of birds of Ceylon, in which he classified birds into three categories, namely, destructive (grain-feeding birds), beneficial (insectivorous birds) and game birds.

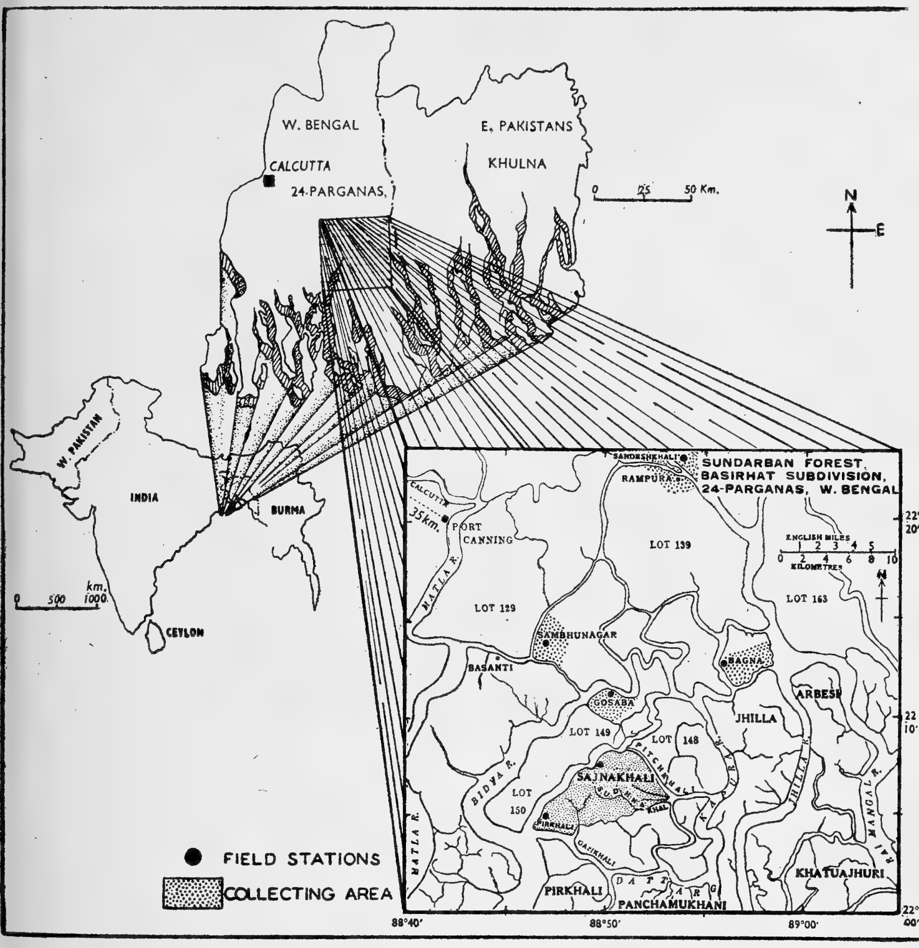
Most of the information, however meagre, on the food of Indian birds affecting agriculture, forestry, poultry, etc., relate to land-birds, and no precise data on water-birds are available in published literature. It is generally believed that the water-birds of lower Bengal live both on aquatic organisms and agricultural products, and thus do a great deal of damage to crops and fisheries. This impression is largely based on tradition, and no proper investigation has so far been made in this direction. It was therefore, thought desirable to make a study of the food-habits of the common water-birds of lower Bengal and to determine their status in the human economy of the area. The results of this study is proposed to be published in instalments.

Study Area

The present investigation was confined mainly to the marshy belt spread over the extreme southern portion of the Gangetic delta in lower Bengal, India. The major portion of this area is covered by the forests of the Sundarban. The northern portion of the Sundarban has been under progressive reclamation since 1790 (Smyth 1857), and a large part of the forest has now come under cultivation and human habitation. The study has been conducted in both the reclaimed and the forested areas of the Basirhat Subdivision, 24-Parganas District, West Bengal. (Text-fig. 1).

The vast cultivated tracts of the reclaimed area, the forest expanse, the network of tidal channels, creeks and rivers, and the estuaries provide ideal feeding grounds for a vast multitude of water-birds of the area. The swampy morasses covered with thick forests and scrubs, which are protected by law, shelter the water-birds and provide them with undisturbed breeding grounds. The forests are dense and largely impenetrable, and are seldom visited by intruders. The legal and natural protection leading to unimpaired breeding have resulted in growth and settlement of large populations of birds in this area. The abundance of water-birds so near Calcutta, which could be studied in a biota peculiar to itself, has prompted me to select the area for study.

The humid tropical forest belt of the Indian Sundarban spreads between the Raimangal and the Hoogly rivers in the east and west respectively and the Bay of Bengal in the south. The northern limit cannot be clearly defined due to progressive reclamation of land, the forest area is considerably reduced. The total area, under Indian administration, is 4096 sq. km., out of which 2320 sq. km., are covered with forests and



Text-fig. 1. Part of the Sundarban forest, 24-Parganas District, showing collecting areas and field stations.

the rest by water. The forests spread over the Gangetic delta which is low, flat and alluvial. The humid forests which grow on such delta are known as 'mangrove swamps'. Following Champion (1936) the vegetation of the Sundarban may broadly be grouped under (*a*) the sea-face (beach) forests, (*b*) the swamp forests, and (*c*) the flora of the reclaimed low-lying cultivated tracts.

The plants that grow on the sea-face islands are mostly xerophytes. Since the islands are subject to strong north-west storms, the trees are stunted and deformed, devoid of branches and are more or less leafless.

The commoner trees of the area are 'Jhao' (*Tamarix troupii*), 'Kulsi' (*Aegiceras corniculatus*), 'Paras-pipal' (*Thespesia populnea*), 'Palita Mandar' (*Erythrina variegata*). Grass lands flourish and sand-dunes are partially covered with bushes. The conspicuous grasses and creepers are 'Udobon' (*Acrostichum aureum*), Spear-grass, 'Khagra' (*Saccharum spontaneum*), 'Ulu' (*Imperata arundinacea*), 'Trikanta-gati' (*Azima tetracantha*) and creepers, such as *Derris* spp., *Caesalpinia* sp. The newly formed islands and banks (*chars*) are first covered by grass, 'Dhani-ghash' (*Oryza coarctata*) and a salt-resistant plant, 'Jadupalang' (*Sesuvium portulacastrum*).

The swamp forests of the Sundarban (Salt-water *Heritiera* forest) are known as mangroves which are largely composed of 'Gargan' (*Rhizophora*), 'Kakra' (*Bruguiera*), 'Goran' (*Ceriops*) and 'Baen' (*Avicennia*). Pneumatophores of *Avicennia* that project above the soil occur everywhere. The stilt-roots of *Rhizophora* and the knee-roots of *Bruguiera* meant for support are adaptive features. 'Sundri' (*Heritiera*) which is found scattered over areas of a slightly higher level, does not seem to have satisfactory natural regeneration. Along with *Heritiera*, *Sonnerita*, *Excoecaria*, *Carapa* spp. etc., form the upper storey. The palms, 'Hental' (*Phoenix paludosa*) which commonly grows gregariously everywhere on higher elevations, and 'Golpata' (*Nypa fruiticans*), present infrequently, are met with on moist mud-banks along the creeks.

The flora of the reclaimed area is rather complex since gradual deforestation and introduction of plants from other parts of India and even from abroad along with cultivation, has brought about a great ecological change. The introduced trees are 'Kul' (*Zizyphus mauritiana*), 'Tentul' (*Tamarindus indica*), 'Neem' (*Azadirachta indica*), 'Payara' (*Psidium guajava*), 'Supari' (*Areca catechu*), 'Narikel' (*Cocos nucifera*), etc. Extensive paddy cultivation is practised wherever salinity of the land has been reduced by human effort. Freshwater marshes having tall reeds such as 'Hogla' (*Typha angustata*), 'Nal' (*Phragmites karka*), 'Sukna' (*Arunda donax*) exist side by side with the saltwater marshes.

The birds were collected from six stations (Text-fig. 1) *viz.*, Sandeshkhali, Sambhunagar, Gosaba, Baghna, Pirkhali and Sajnakhali, as well as on water-routes connecting these stations. The first three stations are situated in the reclaimed area and the rest are in the forested area.

Roughly the operation was restricted to forest lot numbers 139, 140, 148, 149, 150 and 151 (Survey of India Map Index No. 79 B/SE). These lots are islands separated by broad tidal rivers, namely, Bidya, Kapura, Jhilla and Raimangal, and interconnected by creeks.

Method and Material

Although earlier data about the food of birds are based on actual observations in field, photographs, etc., these only give a qualitative knowledge, and no quantitative assessment. For actual quantitative estimation the stomach-contents of the bird must be determined accurately.

There are three methods of determining the food of birds quantitatively, by numerical (items of food counted), volumetric and gravimetric. In addition, Lack (1954) has suggested that the food of birds can be expressed in terms of calories rather than grams. Volumetric method has been recommended by McAtee (1912) and Collinge (1927), but I have followed the gravimetric method for estimation of food, for it gives uniform and more precise data for the estimation of different categories of food. Numerical figures (counts) have also been given wherever possible.

Collinge (1927, p. 34) has suggested the examination of the whole of the intestinal tracts, but to me it seems superfluous for, the items of food taken by a bird retains some recognizable shape and can be identified till they are in the crop or stomach (proventriculus and gizzard), but intestinal contents are exceedingly difficult, if not impossible, to identify. The examination of the bird pellets for study of the food as advocated by Thomson (1923) and Glading *et al* (1940) does not seem to be practical, for only the undigested portions of the food is found in the pellet. I have examined the contents of the stomach and the crop only. For the sake of brevity they have been referred to as stomach-contents. Collection of birds for stomach-contents was started in July 1955 and in successive five years (except 1958), as many as 2617 specimens representing 24 species of water-birds were obtained. Most of the specimens were collected during the early hours of the day between 5 and 9 hours, and late afternoon, generally between 17 and 19 hours in summer, and 16 and 17 hours in winter. Crops and stomachs were dissected out in field within an hour of taking the bird. The contents were separated out into different categories, namely, vegetable matter, animal matter, sand and grit. The animal matter was then broadly separated into different phyla and classes. After weighing the entire stomach-content, each item was weighed separately and group-wise. The vegetable matter was also broadly separated as far as possible. All the animal and vegetable matter were preserved in alcohol.

Items of animal diet were identified in the laboratory of the Zoological Survey of India, and some plants were determined by the Botanical Survey of India.

List of Species Studied

The following species of birds were collected for the study of their food-habits during the years 1955-1960 (excluding 1958). The number against each refers to the number of specimens collected.

Sl. No.	Species	1955	1956	1957	1959	1960	Total
	Family PODICIPEDIDAE						
1.	*Podiceps ruficollis capensis* Salvadori	21	16	32	11	31	111
	Family PHALACROCORACIDAE						
2.	*Phalacrocorax niger* (Vieillot)	102	37	82	18	58	297
3.	*Anhinga rufa melanogaster* Pennant	9	3	1	2	4	19
	Family ARDEIDAE						
4.	*Ardea cinerea rectirostris* Gould	25	6	17	7	21	76
5.	*Ardea purpurea manilensis* Meyen	29	17	8	3	13	70
6.	*Butorides striatus chloriceps* (Bonaparte)	7	3	6	6	4	26
7.	*Ardeolag. grayii* (Sykes)	34	25	10	9	27	105
8.	*Bubulcus ibis coromandus* (Boddaert)	95	97	25	31	70	318
9.	*Egretta alba modesta* (J. E. Gray)	18	12	19	14	7	70
10.	*Egretta intermedia* (Wagler)	92	76	15	19	18	220
11.	*Egretta g. garzetta* (Linnaeus)	68	25	14	11	20	138
12.	*Nycticorax n. nycticorax* (Linnaeus)	18	11	19	23	7	78
13.	*Ixobrychus cinnamomeus* (Gmelin)	3	2	1	—	2	8
	Family CICONIIDAE						
14.	*Anastomus oscitans* (Boddaert)	19	9	25	6	13	72
	Family ANATIDAE						
15.	*Nettapus c. coromandelianus* (Gmelin)	8	5	6	15	9	43
	Family RALLIDAE						
16.	*Gallinula chloropus indica* Blyth	5	3	2	1	1	12
17.	*Fulica a. atra* Linnaeus	11	6	5	—	14	36
	Family JACANIDAE						
18.	*Metopidius indicus* (Latham)	31	12	13	29	31	116
	Family CHARADRIIDAE						
19.	*Vanellus i. indicus* (Boddaert)	60	29	31	29	25	174
20.	*Tringa glareola* Linnaeus	13	7	9	—	9	38
21.	*Calidris minutus* (Leisler)	21	19	15	6	25	86
	Family LARIDAE						
22.	*Chlidonias hybrida indica* (Stephens)	6	3	1	1	2	13
	Family ALCEDINIDAE						
23.	*Ceryle rudis leucomelanura* Reichenbach	132	61	72	9	25	299
24	*Halcyon smyrnensis fusca* (Boddaert)	67	81	12	23	9	192
	Total of each year	894	565	440	273	445	
					Grand Total :		2617

ACKNOWLEDGEMENTS

The plan of the present work prepared in 1955 by me was approved and encouraged by the late Dr. S. L. Hora, then Director, Zoological Survey of India, and I am grateful to him.

I am indebted to the various village headmen of the Sundarban, without whose co-operation, the field-studies and collection of material from little known and intricate waterways and densely forested estuarine islands could not have been completed. I take this opportunity to record my deep gratitude to the late Haradhan Banerjee, a young school teacher, whose great enthusiasm and untiring efforts, were responsible for obtaining material from inaccessible parts of the forests. During the last field trip in 1960, he was tragically lost in the waters of the Sundarban when our boat capsized in a whirlpool at Sandeshkhali.

As is inevitable in a work of this nature which entails identification of various groups of animals and plants obtained from the stomachs of birds, requiring specialists' knowledge, the help of my colleagues at the Zoological Survey of India, was necessary for confirming identifications. I am much indebted to my colleagues who helped me.

I am deeply obliged to Dr. Biswamoy Biswas of this department for his invaluable advice and encouragment from the commencement of the work till its completion. I am indebted to Dr. K. K. Tiwari, also of the same department, not only for encouragement but also for critically going through the manuscript.

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1. FOOD-HABITS OF THE GREBE, CORMORANT AND DARTER

Podiceps ruficollis capensis Salvadori, Little Grebe or Dabchick

The Little Grebe is a permanent resident of the freshwater marshes of the reclaimed area of the Sundarban, and practically every pool, tank and ditch containing enough aquatic vegetation and aquatic organisms harbour the bird.

The bird is sometimes seen singly but it may at times congregate in flocks of some size. It dives below the surface of the water to collect its food, and when it scents danger, it escapes either by swimming away under water or flying away from the spot.

The food as reported by Jerdon (1864, p. 823), Blanford (1898, p. 476), Whistler (1928, p. 422), Baker (1929, pp. 483-484) and Ali (1955, p. 112) consists of tadpoles, small fishes, crustaceans, water-insects and their larvae, molluscs, and its own feathers.

The detailed analysis of the stomach-contents of 111 adult specimens collected by me is given in Table 1.

TABLE 1

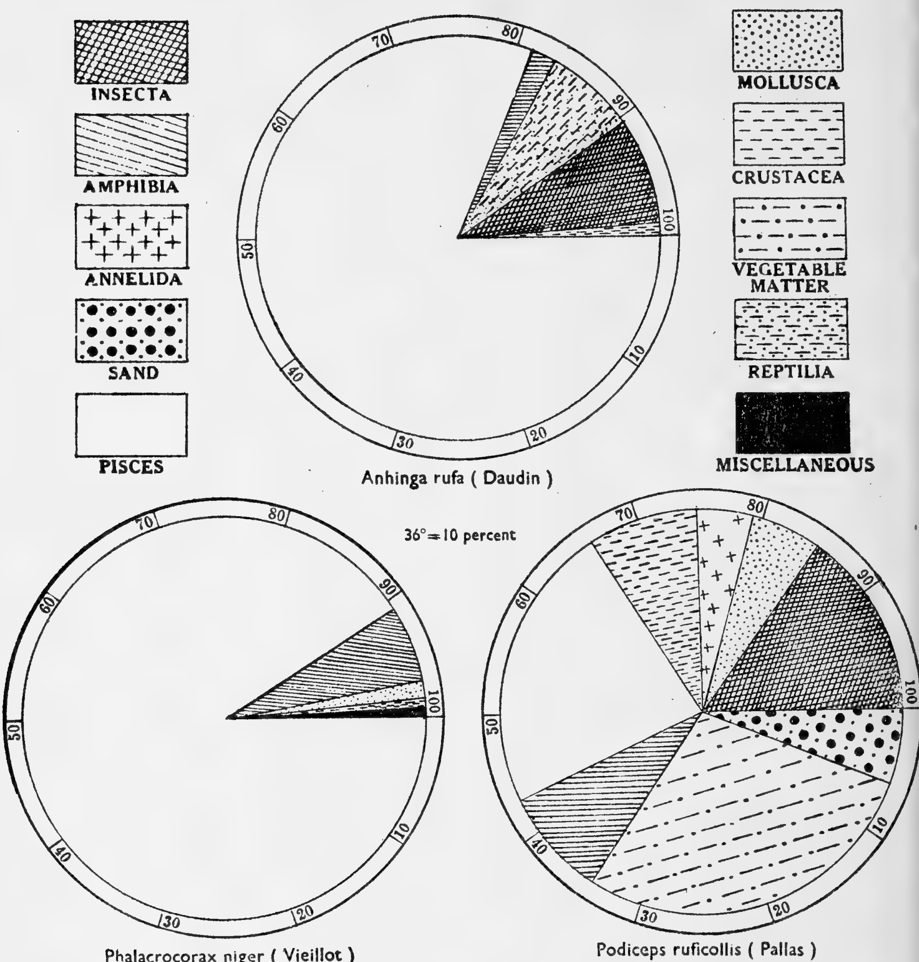
ANALYSIS OF THE STOMACH-CONTENTS OF THE DABCHICK

N = Number of examples.
Weight = Total weight in gramme of examples of all species under a class.
Length of fish = Its standard length.

Items of diet	No.	Wt. (g)	% (Wt.)	Remarks
Phylum Chordata				
Class Aves				
Family PODICIPEDIDAE				
Podiceps ruficollis capensis Salvadori (Feathers)		63	6	
Class Amphibia				
Family RANIDAE				
Rana sp.	135			Partly digested, unidentifiable.
Total :	135	90	8·5	
Class Teleostomi (Pisces)				
Family NOTOPTERIDAE				
Notopterus sp.	25			Length 30-40 mm.
Family CYPRINIDAE				
Puntius sp.	34			Partly digested. Invariably present in stomachs.
Puntius ticto (Hamilton)	21			-do-
Chela sp.	22			Length 5-20 mm.
Family CLARIIDAE				
Clarias batrachus (Linnaeus)	18			Length 20-40 mm.
Family CHANNIDAE				
Channa punctatus (Bloch)	9			Length 15-35 mm.
Family BAGRIDAE				
Mystus vittatus (Bloch)	17			Length 20-40 mm.
Family MASTOCEMBELIDAE				
Mastocembelus pancalus (Hamilton)	6			Length 30-40 mm. Fresh and Brackish water form.
Total :	152	240	22·8	
Phylum Mollusca				
Class Gastropoda				
Family LYMNAEIDAE				
Lymnaea sp.	23			Freshwater form.
Family PLANORBIDAE				
Indoplanorbis sp.	44			
Family VIVIPARIDAE				
Viviparus bengalensis (Lamarck)	19			-do-
Family MELANIIDAE				
Melanoides tuberculatus (Müller)	13			-do-
Total :	99	60	5·7	

Items of diet	No.	Wt. (g)	% (Wt.)	Remarks
Phylum Arthropoda				
Class Crustacea				
Family PALAEMONIDAE				
Macrobrachium lamarrei (Milne-Edward)	76			Freshwater form.
Palaemon styliferus (Milne-Edward)	15			-do-
Total :	91	90	8.5	
Class INSECTA				
Order Odonata (Dragonflies)				
Naiads (Anisoptera)	19			Aquatic form.
Naiads (Zygoptera)	16			-do-
Order Coleoptera (Beetles)				
Family DYTISCIDAE				
Eretes stictus Linnaeus	35			-do-
Laccophilus sp.	41			-do-
Canthydrus sp.	10			-do-
Family GYRINIDAE				
Dinewtes sp.	7			-do-
Gyrinus sp.	23			-do-
Family HYDROPHILIDAE				
Berosus sp.	11			
Hydrophilus sp.	10			
Order Diptera (Flies)				
Family CULICIDAE				
Culex sp.	29			Larvae and pupae.
Family CHIRONOMIDAE				
Chironomus sp.	33			Pupae.
Miscellaneous insect fragments				Not identifiable.
Total :	234	45	15·40	
Phylum Annelida				
Class Chaetopoda				
Order Oligochaeta (Earthworms)				
Family MEGASCOLECIDAE				
Pheretima sp.	10			Mostly bits.
Eutyphoeus sp.	88			-do-
Family NAIDIDAE				
Limnodrilus sp.	100+			In tangled mass.
Total :	198	48	4·30	
Vegetable matter		300	28·50	

It would appear that the Dabchick is a mixed feeder, animal food accounting for 71·5% and vegetable food for 28·5%. The major item of animal food is fish which comprises 22·8%. Besides, it takes earthworms, molluscs, crustaceans, insects, tadpoles and its own feathers (Text-fig. 2). Though there were plenty of waterbugs in tanks, the bird seems to have a distaste for them as none of the stomachs contained any bug. The vegetable matter was mostly algae.



Text-fig. 2. **Diagrammatic representation of the percentages of food of *Anhinga rufa* (Daudin), *Phalacrocorax niger* (Vieillot) and *Podiceps ruficollis* (Pallas).**

Although it consumes some mosquito larvae of public health importance, the amount of commercial fish-fry it devours makes the Dabchick distinctly harmful to pisciculture.

Phalacrocorax niger (Vieillot) Little Cormorant

The Little Cormorant, is one of the commonest water-birds of southern Bengal, seen in the vicinity of brackish water pools, tidal creeks, as well as in the nearby freshwater reservoirs. It congregates in large numbers to form colonies not only for breeding, but feeding and roosting also. The most favourite sites for such colonies are patches of wood that grow on river banks, or overhang tidal creeks.

The food as reported by Jerdon (1864, p. 860), Blanford (1898, p. 340), Mason & Maxwell-Lefroy (1912, p. 278), Whistler (1928, p. 382) and Ali (1955, p. 97), consists mostly of fish and also small crabs, tadpoles, frogs. They are expert divers and catch fish under water.

The detailed analysis of the stomach-contents of 297 adult specimens that I collected is given in Table 2.

TABLE 2

ANALYSIS OF THE STOMACH-CONTENTS OF THE LITTLE CORMORANT

Items of diet	No.	Wt. (g)	%(Wt.)	Remarks
Phylum Chordata				
Class Amphibia				
Order Anura (Frogs)				
Family RANIDAE				
Rana sp.	512			Partially digested beyond identification.
Total :	512	1080	6·14	
Class Teleostomi (Pisces)				
Family BAGRIDAE				
Mystus gulio (Hamilton)	489			Length 30-60 mm. Invariably present in stomachs.
Mystus vittatus (Bloch)	118			Length 30-50 mm. Freshwater form.
Mystus sp.	200			Partly digested.
Family CYPRINIDAE				
Chela sp.	128			Length 30-50 mm.
Puntius sarana (Hamilton)	133			Length 40-60 mm. Fresh water form.
Puntius ticto (Hamilton)	121			Length 40-60 mm.
Catla catla (Hamilton)	127			Length 60-100 mm. Freshwater form.
Labeo bata (Hamilton)	41			Length 40-80 mm. Freshwater form.
Order Anguilliformes				
Anguilla bengalensis (Gray)	100			Length 50-100 mm. Common in tidal creeks.
Family CYPRINODONTIDAE				
Aplocheilus panchax (Hamilton)	60			
Oryzias melastigmus (McClelland)	140			Length 50-100 mm. Common in inundated paddy-fields.
Family MUGILIDAE				
Mugil tade Forskål	45			Length 50-80 mm. Brackish water fish.
Mugil parsia Hamilton	55			Length 70-90 mm. Brackish water fish.
Rhinomugil corsula (Hamilton)	70			Length 60-100 mm. Sea-fish ascending tidal creeks.

TABLE 2

ANALYSIS OF THE STOMACH-CONTENTS OF THE LITTLE CORMORANT (*Contd.*)

Items of diet	No.	Wt. (g)	%(Wt.)	Remarks
Family CHANNIDAE				
Channa punctata (Bloch)	302			Length 60-80 mm. Freshwater form, invariably present in stomach.
Family SYMBRANCHIDAE				
Symbranchus bengalensis (McClelland)	30			Estuarine form.
Family ANABANTIDAE				
Anabas testudineus (Bloch)	202			Length 40-85 mm. Fresh and brackish water form. Invariably present in stomachs.
Family LATIDAE				
Lates calcarifer (Bloch)	44			Length 70-120 mm. Estuarine form.
Family PLATYCEPHALIDAE				
Platycephalus indicus (Linnaeus)	66			
Family NANDIDAE				
Nandus nandus Hamilton	250			Length 60-100 mm. Fresh and brackish water form. Invariably present in stomachs.
Miscellaneous fish remains				Not identifiable.
Total :	2721	14,430	91·09	
Phylum Mollusca				
Class Gastropoda				
Family MELANIIDAE				
Melanoides scabra (Müller)	77			
Family LYMNAEIDAE				
Lymnaea acuminata (Lamarck)	40			
Total :	117	210	1·37	
Phylum Arthropoda				
Class Crustacea				
Family PALAEMONIDAE				
Macrobrachium lamarrei (Milne-Edward)	35			Freshwater form.
Metapeneus brevicornis (Milne-Edward)	42			-do-
Total :	77	130	0·87	
Miscellaneous vegetable matter		100	0·62	Partially digested, beyond identification.

The Little Cormorant feeds very extensively on fishes (91·09%). Altogether 2721 examples of fishes representing 18 species were found in

297 stomachs. Of these, 10 are freshwater forms and eight brackish water, the former being more in proportion compared with the latter. All the fishes that are taken have commercial value. The size of fishes consumed ranges from 30 to 120 mm. in length. Most of the fishes are benthic forms. Besides fish, small quantities of tadpoles (6·14%), molluscs (1·37%) and crustaceans (0·87%) are also consumed (Text-fig. 2).

Out of the 297 birds examined, 125 were from the vicinity of freshwater pools of the reclaimed area and the rest were from the regions of tidal creeks and rivers. The food of the bird collected from two different ecological niches varies to a great extent. The analysis of the stomachs of ten birds of each of the two different niches taken in the same season is as follows :

	Fresh water	Brackish water
Amphibia ..	14·14%	—
Pisces ..	83·00%	98·00%
Mollusca ..	1·37%	—
Crustacea ..	0·85%	2·00%
Misc. vegetable matter ..	0·64%	—

From the foregoing analysis it is apparent that the birds inhabiting freshwater tracts take a mixed diet comprising of fish, Amphibia (tadpoles), Mollusca, Crustacea and a small proportion of vegetable matter, whereas those dependent on creeks and estuaries are on the whole fish-eaters with, but a small proportion of Crustacea included in the diet.

All my specimens were collected in the morning between 6 and 9 hours, that is soon after the morning meal. The average stomach-content was found to be 60 gm. per bird. Throughout the day the Little Cormorant keeps itself busy feeding. It was found to have five principal meals on an average during the day, and each individual takes approximately 300 gm. of food daily. It is a voracious eater and causes an appreciable effect upon fish population. In a square kilometre area a population of a thousand birds is not an over estimation. Such a population would take fishes to the extent of 108,000 Kg. annually and is to be considered as a bird harmful to fisheries.

Anhinga rufa melanogaster Pennant, Darter or Snake-bird

The Darter, *Anhinga rufa melanogaster* Pennant, is not uncommon in the Sundarban. It generally confines itself to the *gheries* (backwater fisheries) and is usually noticed on perches overhanging water from where it can easily dive for fishing. Found singly or in pairs and sometimes in association with the Little Cormorant. It prefers undisturbed, deep, freshwater pools or estuarine lagoons.

The food as reported by Jerdon (1864, p. 866), Blanford (1898, p. 384), Baker (1929, p. 283) and Ali (1955, p. 98) consists solely of fish which is captured under water.

Regarding the food of the allied species, *Anhinga anhinga* Baker (1889, p. 266) examined contents of five stomachs and found fishes up to 14 inches (35·56 cm.) in three male and small fishes in two females. Baynard (1912, p. 167) noted that it fed its young ones chiefly on suckers, pickrels and a few catfishes, none of much economic value. Bent (1922, p. 233) found in the stomachs examined by him various kinds of fishes, aquatic insects, crustaceans, leeches, amphibians, young alligators, snakes and terrapins.

The detailed analysis of the stomach-contents of 19 adult specimens that the author collected is given in Table 3.

TABLE 3

ANALYSIS OF THE STOMACH-CONTENTS OF THE DARTER

Items of diet	No.	Wt. (g)	%(Wt.)	Remarks
Phylum Chordata				
Class Reptilia				
Order Squamata (Lizards & snakes)				
Suborder Serpentes (Snakes)				
Family COLUBRIDAE				
Natrix piscator (Schneider)	2			Partly digested and in pieces.
Enhydris enhydris (Schneider)	1			
Total :	3	74	7·40	
Class Amphibia				
Family RANIDAE				
Rana sp. (Tadpoles)	12			Partly digested.
Total :	12	20	2·00	
Class Teleostomi (Pisces)				
Family NOTOPTERIDAE				
Notopterus notopterus (Pallas)	27			Length 60-130 mm. Common in fresh and brackish water ponds.
Family CYPRINIDAE				
Chela sp.	3			Length 60-80 mm.
Puntius sp.	7			Length 50-60 mm.
Cirrhinus sp.	4			Length 50-120 mm.
Family PLOTOSIDAE				
Plotosus anguillaris (Bloch)	9			Coastal form, quite common in tidal creeks.
Family SCHILBEIDAE				
Pangasius pangasius (Hamilton)	8			Partly damaged and digested.
Family CLARIIDAE				
Clarias batrachus (Linnaeus)	11			Length 100-150 mm. Very common in fresh and brackish water pools.

Items of diet	No.	Wt. (g)	%(Wt)	Remarks
Family BAGRIDAE				
Mystus(?) *gulio* (Hamilton)	49			Partially digested. Invariably present in stomachs.
Family CYPRINODONTIDAE				
Aplocheilus panchax (Hamilton)	3			
Oryzias melastigmus (McClelland)	2			
Family MUGILIDAE				
Rhinomugil corsula (Hamilton)	6			
Family CHANNIDAE				
Channa punctata (Bloch)	13			Mostly head, fins and part of skeleton.
Family LATIDAE				
Lates calcarifer (Bloch)	6			Length 70-110 mm. Very common in *gheries*.
Family SCIAENIDAE				
Pseudosciaena sp.	2			
Family NANDIDAE				
Nandus nandus (Hamilton)	15			Length 50-90 mm. Invariably present in stomachs.
Family PLATYCEPHALIDAE				
Platycephalus indicus (Linnaeus)	2			
Family SYMBRANCHIDAE				
Symbranchus bengalensis (McClelland)	9			
Family AMPHIPNOIDAE				
Amphipnous cuchia (Hamilton)	22			
Family MASTOCEMBLIDAE				
Mastocembelus pancalus (Hamilton)	14			Length 80-110 mm. Quite common in *gheries* Invariably present in stomachs.
Mastocembelus armatus (Lacépede)	3			
Miscellaneous fish remains				
Total :	215	812	81·20	
Phylum Arthropoda				
Class Crustacea				
Family PENAEIDAE				
Metapenaeus sp.	1			
Family PALAEMONIDAE				
Macrobrachium lamarrei (Milne-Edward)	1			
Total :	2	10	1·00	
Class Insecta				
Order Hemiptera (Bugs)				
Family BELOSTOMATIDAE				
Belostoma sp.	6			
Order Odonata (Dragonflies)				
Family AESHNIDAE				
Naiads	40			Partially digested.
Family COENAGRIIDAE				
Naiads	30			
Miscellaneous insect fragments				Not identifiable.
Total :	76	84	8·40	

The bird is chiefly a fish-eater, fish constituting 81·2% of its diet. In 19 stomachs altogether 216 examples of fish were found, representing 21 species, of which six are fresh water and 15 brackish water, and all of commercial value. It is a voracious feeder for the collections made in the morning between 6 to 9 hours reveal that each bird consumes about 43 gms. of fish per meal. It has six major meals during the day, which suggests that each bird consumes daily approximately 250 gms. of fish alone. It prefers large-sized fish ranging from 50-150 mm. in length and specially those that inhabit deep water. Next to fish it consumes soft-bodied aquatic insects (8·4%) and estuarine snakes (7·4%). It also takes very small quantities of tadpoles (2%) and crustaceans (1%) (Text-fig. 2).

Since its staple diet is fish and that too of commercial value, it may be regarded as a bird harmful to fisheries.

(*to be continued*)

E. P. Gee

(1904-1968)

Obituary

E. P. GEE

(*With a plate*)

The death of E. P. Gee on 22nd October, 1968, is the grievous loss of a valued friend to the Society and to the Wildlife Conservation movement in India.

Edward Pritchard Gee was born in 1904 in County Durham and was educated at Durham School and Immanuel College, Cambridge. He spent his working life as a planter in Assam retiring in 1959 to reside at Shillong.

Gee, a dedicated conservationist, found on retirement, the time he needed for incessant advocacy of the cause of wild life conservation in India both by the written and the spoken word. He rendered invaluable service to the Indian Board for Wild Life from the time of its formation, and was the Eastern Regional Secretary of the Board for many years until his death. As a member of the Survival Service Commission of the International Union for the Conservation of Nature and Natural Resources, he was able to maintain close liaison with international bodies and the foremost naturalists of the world, and was able to promote several basic ecological studies in India. He had drawn up a list of terms for the Indian Board for Wild Life, and a Model Bill for the States to adopt, so that the law relating to National Parks and Sanctuaries might be standardised throughout the Indian Union—a measure of vital importance under the conditions prevailing in the country. Unfortunately his hint has not been taken, and several states have yet to enact suitable legislation.

Gee was a naturalist in the truest sense of the word. A perfectionist, who was willing to spend his energy and time in tireless field observation and photography of wild life. His precise notes on wild life, and conservation problems and outstanding photographs of animals and flowers are ample evidence of his knowledge and expertness. He was an enthusiastic gardener, and orchid collector. His garden in Shillong contained some of the rarest species of the eastern Himalayas collected by himself on the special expeditions he was constantly making to remote parts of the region.

Gee will be remembered for his book THE WILD LIFE OF INDIA which has done so much to focus public attention and interest on the fauna of the country and the need for its conservation. Also as the discoverer of the Golden Langur in Bhutan which has been named *Presbytis geei* after him.

E.P. as he was known to his friends leaves memories of his generosity, hospitality, enthusiasm and intense interest in India's flora and fauna, and an abiding love for the people and wild life of the country, in which he had chosen to spend the evening of his life.

Gee joined the Society in 1931 and was a member of its Advisory Committee from 1953. He took the closest interest in its activities and was always ready to help in whatever way he could to further its interests. He has left to the Society all his books, films, photographs, and papers on wild life. The Society will always remain deeply indebted to him.

A list of his publications in the *Journal* is given below.

1933 Note on the Indo-Burmese Pied Hornbill (*Hydrocissa malabaricus leucogastra*). (*with a plate*). **36** (2) : 505-506.

—— Note on the development of the casque of the Indo-Burmese Pied Hornbill (*Anthracoceros albirostris*). (*with a plate*). **36** (3) : 750-751.

1937 Strange behaviour of a Tigress. **39** (3) : 614.

—— The size of the Jungle Cat (*Felis chaus affinis*). (*with a plate*). **39** (4) : 850-851.

1947 On the Leopard Cat (*Prionailurus bengalensis*). (*with a photo*). **47** (2) : 371.

1948 Black Leopard cubs. (*with a photo*). **48** (1) : 173-174.

1949 A possible cause of blank days when Mahseer Fishing. **48** (3) : 598-599.

1950 Wild Life Reserves in India : Assam. (*with 2 plates, a map and a table*). **49** (1) : 81-89.

—— Wild Elephants dying in Assam. **49** (1) : 113-114.

—— Effect of atmospheric pressure while fishing. (*with a photo*). **49** (1) : 128-129.

—— Wild Elephants dying in Assam. **49** (2) : 296.

1951 Effect of atmospheric pressure while fishing. **49** (4) : 794-795.

—— What is the best means of control and destruction of Flying Foxes [*Pteropus giganteus* (Brunn.)]. **50** (2) : 401.

1952 The Assam Earthquake of 1950. (*with a map and two plates*). **50** (3) : 629-635.

—— The Management of India's Wild Life Sanctuaries and National Parks (*with four plates*). **51** (1) : 1-18.

—— Possible occurrence of the Snub-nosed Monkey (*Rhinopithecus roxellanae*) in Assam. **51** (1) : 264.

—— What is the best means of control and destruction of Flying Foxes [*Pteropus giganteus* (Brunn.)]. **51** (1) : 268.

—— Extermination of Snakes upsets balance of nature. **51** (1) : 280-281.

1953 The Life History of the Great Indian one-horned Rhinoceros (*R. unicornis* Linn.). (*with a plate*). **51** (2) : 341-348.

—— Wild Buffaloes and Tame. (*with a photo*). **51** (3) : 727-730.

—— Mystery Predator. **51** (3) : 732.

—— Further observations on the Great Indian one-horned Rhinoceros (*R. unicornis* Linn.). (*with two plates*) **51** (4) : 765-772.

—— Notes & News : Wild Life in India. **51** (4) : 967-968.

1954 Wild Life Preservation in India : Annual Report for 1953 on the Eastern Region. **52** (2&3) : 233-240.

1955 The Management of India's Wild Life Sanctuaries and National Parks, Part II. (*with four plates*). **52** (4) : 717-734.

—— The Brow-antlered Deer (*Cervus eldi* MacClelland). (*with a plate*). **52** (4) : 917-919.

—— The Function of Zoological Gardens in the preservation of Wild Life. (*with four plates*). **53** (1) : 79-85.

—— The Indian Elephant (*E. maximus*) early Growth Gradient and intervals between calfing. (*with four plates*). **53** (1) : 125-128.

—— A new species of Langur in Assam. (*with a sketch map*). **53** (2) : 252-254.

—— Great Indian one-horned Rhinoceros (*R. unicornis* Linn.) cow with (presumptive) twin calves. **53** (2) : 256-257.

1956 The management of India's Wild Life Sanctuaries and National Parks, Part III. (*with one coloured plate and five black and white plates*). **54** (1) : 1-21.

—— Lion *v*. Tiger. **54** (1) : 171-173.

—— Predator and Prey at Salt-Licks. **54** (1) : 181.

1958 Bharatpur ' Wild ' Cattle. (*with a plate*). **55** (2) : 338-339.

—— The Shou or ' Sikkim Stag '. An appeal for information on its present status. (*with a plate*). **55** (3) : 556-558.

—— The present status of the Whitewinged Wood Duck, [*Cairina scutulata* (S. Müller)]. (*with a plate*). **55** (3) : 569-575.

1959 The Great Indian Rhinoceros (*R. unicornis*) in Nepal. Report of a fact-finding survey, April-May 1959. (*with three plates and three maps*). **56** (3) : 484 510.

—— Albinism and Partial Albinism in Tigers. (*with a plate*). **56** (3) : 581-587.

1960 The breeding of the Grey or Spottedbilled Pelican, *Pelecanus philippensis* Gmelin. (*with four plates*). **57** (2) : 245-251.

—— Report on the status of the Brow-antlered Deer of Manipur (India) : October-November 1959 and March 1960. (*with three plates and three maps*). **57** (3) : 597-617.

1961 The distribution and feeding habits of the Golden Langur, *Presbytis geei* Gee (Khajuria, 1956). (*with two maps and three plates*). **58** (1) : 1-12.

—— The Wildfowl Trust at Slimbridge in Britain. (*with two plates*). **58** (2) : 429-432.

—— Some notes on the Golden Cat, (*Felis temmincki* Vigors & Horsfield). (*with two plates*). **58** (2) : 508-511.

1962 The Management of India's Wild Life Sanctuaries and National Parks, Part IV. (*with two plates*). **59** (2) : 453-485.

—— A Leopard Cat (*Felis bengalensis* Kerr) in captivity. (*with a plate*). **59** (2) : 641-642.

1963 The Indian Wild Ass : A Survey—February 1962. (*with a plate and a map*). **60** (3) : 516-529.

1965 Report on the status of the Kashmir Stag : October 1965. (*with one coloured and four monochrome plates*). **62** (3) : 379-393.

1966 A Note on the Conference on Conservation of Nature and Natural Resources in Tropical South-east Asia held at Bangkok, Thailand—November 29 to December 4, 1965. (*with a plate*). **63** (1) : 162-166.

1967 The Management of India's Wild Life Sanctuaries and National Parks, Part V. **64** (2) : 339-341.

—— Occurrence of the Brown Bear, (*Ursus arctos* Linnaeus) in Bhutan. **64** (3) : 551-552.

—— Occurrence of the Snow Leopard, *Panthera uncia* (Schreber), in Bhutan. **64** (3) : 552-553.

—— Occurrence of the Nayan or Great Tibetan Sheep, (*Ovis ammon hodgsoni* Blyth) in Bhutan. **64** (3) : 553-554.

Reviews

1. THE PROBLEMS OF BIRDS AS PESTS. (Proceedings of a Symposium held at the Royal Geographical Society, London, on 28 and 29 September 1967.) Edited by R. K. Murton and E. N. Wright. 254 pp. (15×23 cm.). Academic Press, London & New York. Price 70*s*.

In the context of our fast-changing world this is a timely publication, of very direct usefulness and importance to those who must try to resolve the increasing conflict between birds and men. The two main topics discussed at the Symposium were Birds and Aircraft and Birds and Agriculture. Many of the specialists taking part were at the same time ornithologists or conservationists, or both; therefore their views bear the stamp of authority.

As the Chairman of the Symposium, Sir A. Landsborough Thomson stressed in his Introduction, this Symposium was not conceived in any spirit of hostility of bird life, and it is refreshingly obvious from the Proceedings that the discussions were conducted dispassionately and objectively to determine the facts and consider what to do.

Birds and Aircraft is a subject of mounting concern. The advent of the jet engine and the increasing speed and size of modern aeroplanes, especially military aircraft, have considerably enhanced the hazards of collision with birds. The danger from bird strikes is particularly great to low-flying military aircraft while trying to avoid radar detection, or in the process of take-off or landing. Jet engines are vulnerable to serious crippling, or even complete failure, after sucking in a bird or several from a flock, and the number of such accidents is increasing daily with the increase in air traffic throughout the world. Many very serious mishaps have occurred in recent years involving loss of life and wrecking or heavy damage to expensive aircraft. The problem is of mounting concern to every one connected with the business of flying—passengers, airlines, military air services as well as aircraft designers. In this country the Bombay Natural History Society is constantly receiving from the Indian Air Force authorities feathers and battered remains of birds sucked in by the jet engines of military planes. This has sometimes resulted in serious accidents, and in all cases necessitated expensive repairs. The hazard from direct strikes by large birds mostly kites and vultures is also considerable, especially in the neighbourhood of airfields.

Research along many lines is being zealously pursued in many countries of Europe, and in America, to find practicable solutions to this growing menace. Many ingenious methods have been tried with varying degrees of success. Many others continue to be devised and experimented with to keep birds away from airfields. These include playing back tape-recorded alarm and distress calls of the birds through a network of loudspeakers around the runways, modifying the habitat by removal of sand-dunes, and other natural features that produce favourable air currents for low-level soaring and gliding by certain large birds, and noisy automatically firing scaring devices to keep birds out of the way of aeroplanes. Some of the measures prove moderately successful at first, but the birds soon become 'acclimatized' to the innovations and revert to their old ways. Side by side with these continue endeavours on the part of aircraft designers to add physical protection to aircraft against bird-strikes or modify the design to make them inherently safer in this regard. The opening chapter of the Proceedings gives a comprehensive survey of the Problems of Birds and Aircraft. Another on Recent Developments in Bird-scaring on Airfields is especially illuminating, and the discussions amongst the participants in the Symposium which follow add to its usefulness. Some of the developments cited are dealt with specifically and in detail in the other chapters. There is one chapter, tantalizingly interesting but—perhaps too technical for the non-specialist—on Bird Recognition by Radar: A Study in Quantitative Radar Ornithology—a subject which by providing in advance an indication of the size, weight, manner of flight, etc. of the bird or birds on the radar screen, is shown to have a direct application to the strike hazard problem.

Birds and Agriculture is another topic of very immediate and considerable interest to us in India. Unfortunately sufficient importance is not attached to the problem by our agricultural authorities in spite of its obvious potentiality for making the 'Green Revolution' greener if tackled scientifically and in the right manner. It is admittedly a complex investigation, but studies in European countries and in America have proved that the research is well worth while. In the context of the growing mechanization of our farming, and the changing pattern of agriculture due to modern techniques, the Symposium on birds and agriculture is especially relevant. Some birds are responsible for direct damage to crops by devouring grains, some confer direct benefit, may be to the selfsame crops, by devouring highly injurious insect pests. Other species play a dual role—harmful at one season, beneficial at another. The goal of research in Economic Ornithology is first to determine, by intensive life history studies, which species are harmful on balance and which beneficial, and having done so to devise practicable methods to encourage the good ones and discourage the bad. Outright slaughter of visibly harmful species may look like an easy short-cut, but it is not the answer.

Four chapters in the proceedings deal specifically with individual birds or bird groups: The Rook Problem in NE. Scotland, Bullfinches and Fruit-buds, The Oystercatcher as a pest of Shellfisheries, and the Quelea Problem in Africa. Two other chapters entitled 'Some Predator-Prey Relationships in Bird Damage and Population Control', and 'Urban Bird Populations' are of wider general application. The discussions of the various problems by the participating experts bring out in relief a spate of valuable supplemental information and offer suggestive ideas for the planning and execution of similar studies in India. The Symposium has been a meaningful and highly rewarding exercise. Ornithologists, and even persons not directly connected with the problems dealt with, will find the Proceedings inspiring and of much practical usefulness.

S.A.

2. THE OXFORD BOOK OF INSECTS. Illustrations by Joyce Bee, Derek Whiteley, and Peter Parks. Text by John Burton, with I. H. H. Yarrow, A. A. Allen, L. Parmenter, and I. Lansbury. pp. viii+208 (24×17 cm.). 96 plates in colour. London, 1968. Oxford University Press. Price 50*s*. net.

This book continues the high standard of its predecessors in the series THE OXFORD BOOK OF BIRDS and THE OXFORD BOOK OF FLOWERLESS PLANTS, which have already been noticed in the beautiful coloured illustrations, drawn from life or from a combination of preserved specimens and colour photographs, recording form and colour in minute detail and calculated to make for easy identification. About 800 different insect species, a fair selection of the 25 Orders of British Insects, are illustrated in 96 plates, as many as ten (in a few cases, more) being collected on a single plate without making it appear unduly crowded. The plates are arranged under certain broad heads, such as: Wingless Insects; Dragonflies and Damselflies; Mayflies, Stoneflies, and Earwings; Crickets, Grasshoppers, etc., and so on. The accompanying text takes shape accordingly, a general commentary, followed by short notes on each of the forms illustrated. Short as are these commentaries and notes, John Burton and his specialist helpers have made them both informative and interesting. Technical language has been largely avoided. Tucked away modestly at the back of the book are a short explanation of insect classification, an equally short description of insect structure, a brief account of the 25 Orders of British insects, and finally something about 'Metamorphosis of Insects' and 'Protection from Enemies'. The book ends with a bibliography, classified under the heads: A, suitable for beginners; B, for identification and general reading; and C, books of reference.

This is the sort of book that makes one look longingly and say to oneself: Why cannot we have books like this for our country? The answer suggests itself: Perhaps we will, in time, if our people, especially those of the coming generation, are given sufficient opportunities of seeing such books. Apart from this consideration, the book should find ready sale in India as many of the insects illustrated here are either found in India or are closely related to Indian forms.

The book is well worth the price asked for.

D. E. R.

3. A CEREMONIAL OX OF INDIA. The mithan in nature, culture, and history—with notes on the domestication of common cattle. By Frederick J. Simoons with the assistance of Elizabeth S. Simoons and illustrations by Gene M. Christman. pp. xvi+323 (23×15 cm.). Madison, Milwaukee, and London, 1968. University of Wisconsin Press. Price $ 11.

The authors were in southern Asia in 1963-64 investigating dairying and the use of milk 'from a geographic and culture historic point of view', trying in particular to locate groups which were reluctant to consume milk as food. This was when they became aware of the mithan, *Bos frontalis*, 'a strange-looking domesticated bovine animal which was not milked'. They set themselves to find out all they could about this little-known animal, and this book is the result. There is an 18-page list of references, in which the only surprising omission is T. H. Lewin's A FLY ON THE WHEEL, that excellent book commended by *Hobson-Jobson* in which the animals are described as 'beautiful creatures, with broad fronts, sharp wide-spreading horns, and mild, melancholy eyes' with a call 'something between a bull's bellow and a railway whistle'. Not content with books, the authors corresponded with J. H. Hutton, C. R. Stonor, C. von Fürer-Haimendorf, H. E. Kauffmann and others who had lived in mithan country, and with George

Schaller who made proofs of THE DEER AND THE TIGER available to them. It was obviously a labour of love, and the result is a convincing, well-organized, well-illustrated and well-indexed book of mithan-lore. The animal has many hybrid forms, and is to be found today in a browsing niche between 2000 and 9000 ft. in the forested hills between Bhutan and Arakan. It is used for sacrifice and currency, but not traction or milking, by the Apa Tani, Lhota Naga and many other tribal peoples, some of whom are here described.

The conclusion is that the present condition of the mithan—free-ranging, feeding itself and having little contact with man—is typical of the earliest domesticated cattle. Early man wanted bovines for sacrifice, to ensure the preservation of his family and the fertility of his crops. It was only much later that he needed the daily presence of bovines for ploughing or milking. The authors sum up: 'The archaeological evidence at present available suggests that the earliest bovine domesticates, found from Afghanistan to Hungary, were common cattle, and that these were the first domesticated bovines involved with the (fertility) cult. If common cattle were indeed earliest, the domestication of the water buffalo and gaur in India was probably in imitation of common cattle. We believe that the mithan was first domesticated in imitation of water buffalo; that the domestication was carried out somewhere in the Naga-Chin country, by ancestors of one of the present-day groups or by some "Tibeto-Burman" group that preceded them; and that fertility concerns and sacrificial needs were important in the domestication'.

R. E. H.

4. THE WILD ANIMALS OF BURMA. By U Tun Yin. pp. xi+301 (16·5×24·5 cm.). Rangoon, 1967. Rangoon Gazette Ltd. Price not marked.

After the War, almost no information of natural history matters has come in from Burma. It was, therefore, a pleasant surprise to see this book. As explained in the Preface, it is mainly a compilation and large portions of the text are verbatim quotations from earlier publications.

All species of mammals occurring in Burma are not mentioned, rats, bats and shrews at least being excluded. There is no indication as to how the selection has been made. The Introduction contains a summary of the history of mammalogical work in Burma, and it is significant that subsequent to the paper on the Rhinoceros (published in this Journal in 1947), the only reference is to the collection of some mammals by a botanist in the Tavoy and Myitkynia Districts in 1961-62. In the long bibliography at the end, the bulk of the references come from the Bombay Natural History Society's Journal.

On page 110 is cited a description from Kingdon Ward's RETURN TO THE IRRAWADDY (1956) illustrated by a photograph of a skin on the opposite page said to be of an undescribed species of cat. Burma is still the naturalist's El Dorado and we can only hope that this effort will serve the author's main purpose, which is 'to mould the correct attitude towards nature in the youth of today, who will be the citizens of tomorrow', to instil in them the desire to conserve wild life and for that purpose to learn to know wild animals and their ways and habits.

H. A.

5. THE DANCE LANGUAGE AND ORIENTATION OF BEES. By Karl von Frisch—Translated by Leigh E. Chadwick. pp. xiv+566 (19·5×26 cm.). Cambridge 1968. Harvard University Press. Price $ 15.00.

The book is a translation of '*Tranzsprache und Orientierung der Bienen*' by Karl von Frisch published by Springer-Verlag, Berlin, 1965. The book is the culmination of a life time research work of a gifted research worker and teacher under whose inspiring leadership, the mysteries of the communication system among bees were unravelled. It is also a well arranged chronological record of the various stages through which the investigations progressed, the difficulties that were encountered and how the same were surmounted. The various experiments were planned with meticulous care and executed with great thoroughness. Any observations that did not fall in line with the general concept of the workers were carefully considered and if necessary the previous concept was modified. Comparative studies were instituted on various races of the European hive bee in Europe and other countries and on sister species of bees in Ceylon for securing information on the evolution of the behaviour pattern in the super-family Apoidea. The book includes a mass of work reported on the subject by investigators other than those belonging to the von Frisch group.

Briefly, communication among bees is through rhythmic movements (round and tail wagging dances) performed on the combs of the colony. Early in the morning scout bees go out in search of food. After finding a source they return to the hive to perform meaningful dances with a view to intimating to their colleagues the nature of their finding, its abundance and location. Through the varied nuances of the dance, its tempo, length of the last run, the direction in which it is concluded, intensity of the buzzing noise and subsequent manner of association with interested onlookers, the scout is able to convey the exact location of the nectar, pollen, water or propolis (resin) or nesting site. Scout bees are also able to utilize such landmarks as trees, hedges, the sun, and the plane of polarisation of light to orient themselves.

The author takes cognizance of the criticism advanced against his work through the years and gives his point of view in a polite though convincing manner. He also points out the gaps in knowledge about the dance language of the bees and indicates the directions in which further work may proceed. The book is a landmark in the study of animal behaviour and the author's work has led to similar studies having been initiated in other invertebrate and vertebrate animal groups and the role of the plane of vibration of polarised light in orientation of different species of animals is now well recognised. At various places in the book the author encourages other workers to confirm his findings for themselves by watching the behaviour pattern of the bees and gives elaborate directions for undertaking experiments on different aspects of bee behaviour. The book will long remain the classic reference book for students of animal behaviour and will become the starting point for studies on social insects.

The book is profusely illustrated with photographs, figures and line drawings which are conveniently placed near the text. Over 800 references are cited. Specific page references in the text to the papers of other workers are likely to prove helpful in readily tracing any particular reference. The printing and production of the book is flawless and is most helpful to the reader in going through it from cover to cover.

The translator has done an excellent job of presentation of the material and in conveying the various details of the experiments and interpretation of results and discussion. It is written in simple and easily understandable language and the interest of the reader is sustained throughout.

S. S.

6. BIRDS OF KERALA (second edition of THE BIRDS OF TRAVANCORE AND COCHIN). By Sálim Ali. pp. xxiii+444 (16·5×24 cm.) +22 plates (16 in colour by D. V. Cowen)+many pen-and-ink sketches+end-paper maps. Bombay, 1969. Oxford University Press. Price Rs. 35.00.

Soon after its publication in 1953, Dr. Sálim Ali's excellent work on the birds of Travancore and Cochin went out of print. Meanwhile, these two erstwhile princely States became Kerala, with certain geographical addition (Malabar District on the north) and deletion (Kanyakumari District on the south). Faunistically, considerable new ornithological data piled up during the intervening years. A second edition of the book was, therefore, necessary and it has come out none too soon under a revised title, with a thorough revision of the earlier text necessitated by the accumulation of additional ornithological data and political changes in the geographical extent of the area following the formation of the State of Kerala.

The sequence of the birds dealt with has been changed in the present edition to conform to the recent trend, and information on several additional birds has been incorporated. A page of 'glossary' has also been added. Neatly drawn (and reproduced) end-paper maps are a distinct improvement on the earlier edition, reinforced by an attractive dust-jacket with a sketch by J. P. Irani. Most of the plates have been as beautifully reproduced as in the first edition. The paper used for printing the text is whiter, and appears more durable, though somewhat thicker.

Most of the weaknesses of the earlier edition have been taken care of in the present one. Nevertheless, abbreviated references, namely FAUNA and NIDIFICATION used throughout the book, have not been introduced anywhere to denote that they refer to Stuart Baker's works (and a new one has now been added, namely, SYNOPSIS to refer to Ripley's book); and two systems of linear measure, metric in the text and English in the plates, still persist.

A few other points are worth mention. The word 'race' has been used throughout the book (and 'form' once in a while) to denote subspecies, and 'typical' has sometimes been used to mean nominate. In the Introduction, the data concerning Hora's Satpura Hypothesis has not been brought up to date, specially about the Garo-Rajmahal Gap. While all the zoological names have been brought up to date, the diphthong was still been used for *ae* in *ichthyaetus* (p. 65) and *haliaetus* (p. 75), and the diacritical mark (′) used for *a* in *salimalii* (pp. 351, 416)—which is not permissible under Art. 27 of the Code of Zoological Nomenclature. Under 'Distribution outside Kerala' for many birds, Assam has been listed separately from India. The species *Dendrocopos nanus* (p. 245) does not extend to Assam, Burma, Yunnan and Malaysia, where two other allied species, *D. canicapillus* and *D. moluccensis* (in Malaysia), occur. The correct generic name for the Blacknaped Flycatcher (p. 348) is *Hypothymis* Boie, 1826, for it antedates *Monarcha* Vigors and Horsfield, 1827. Distribution outside Kerala of the Whitethroated Ground Thrush (p. 384) is out of date (see Abdulali, 1965, *JBNHS*, **62**: 305-306). No chestnut is apparent in figs. 2, 6 and 7 on Plate 12 (facing p. 161); and colours of bills and lappets in figs. 1 and 3 on Plate 17 (facing p. 288) and of chin and throat in fig. 3 on Plate 22 (facing p. 385), have not been correctly reproduced.

Notwithstanding these minor blemishes, the book lives quite up to the standard of Dr. Sálim Ali's works, and this important and valuable contribution to Indian ornithology is bound to enjoy the same popularity as its previous edition did.

BISWAMOY BISWAS

Miscellaneous Notes

1. AN ENCOUNTER BETWEEN WILD DOGS AND SAMBAR

Seeing a pack of wild dogs chase a herd of spotted deer across our property in the jungle beside the Sigur River in the lower plateau of the Nilgiris I dashed after them armed with my cameras.

By the time I reached our neighbour's cattle pen I had lost sight of the hunt. In answer to my enquiry the herdsman told me that the deer had escaped across the open ground behind our property while the dogs giving up the chase had run back to the river, a little upstream from our property and indicated the general direction in which they had gone. I followed. When I reached the river the dogs were nowhere to be seen. So I decided to wait for a while and got into one of the hides I have put up along the river.

I had not been sitting for more than 15 minutes when I heard the scream of a fawn in distress. I leaned forward and saw, some 75 yards downstream, a month old sambar fawn rushing into a shallow pool followed by some wild dogs and one of them actually worrying the fawn. In a moment the fawn was surrounded by about half a dozen hinds and they were all lashing out at the dogs with their fore-feet.

I clambered down from my machan and approached the scene of battle. As soon as I had got clear of some major obstructions I crouched behind a bamboo clump to watch and photograph the scene. By this time there were about 10 hinds in the river and the dogs were on the run.

Two dogs crossed the river lower down and approached the deer from the other bank. Thereupon two of the larger hinds got out of the water and gave chase. It was incredible. I continued to sit and watch. After a short interval two dogs re-appeared. Again two large hinds ran after them and chased them away.

Had I not witnessed it, I would never have believed that such a thing could happen and that sambar hinds could be so bold and aggressive towards the dreaded wild dog and that deer were capable of such concerted action in an emergency. Nor for that matter that a pack of wild dogs could be routed by such inoffensive animals like sambar hinds, particularly since in this same area a year previously, I had seen a full grown panther shoot up the tall, straight, bole of

a tamarind tree and take refuge in the branches above, in sheer fright at the sight of a few wild dogs which were merely passing that way.

I can think of only one explanation for the action of the deer. This wild dog pack had been hunting in our area for over a month and the sambar had probably got used to them and for the sake of protection had gathered together and acted in the manner in which they did quite unconscious of the danger involved.

KING & PARTRIDGE,
SOLICITORS,
OOTACAMUND,
NILGIRIS,
November 26, 1968.

E. R. C. DAVIDAR

2. THE CASPIAN TIGER *PANTHERA TIGRIS VIRGATA* (ILLIGER)

(*With a plate*)

Except for a few tigers in northern Iran (near the south-eastern shore of the Caspian Sea) and northern Afghanistan (?) and for stragglers in southern Turkmenia (U.S.S.R.) the Caspian tiger, *Panthera tigris virgata* (Illiger 1815) appears to be extinct (Perry 1964; Sludskyi 1966; Kirk 1968).

A hundred years ago the Caspian tiger's range extended as far west as the south of the Caucasus (exceptionally Tiflis). Eastwards across central Asia from the Caspian, through northern Persia (Mount Elburz), northern Afghanistan, to Aral Sea, under the Pamirs, River Ili (Plate), Lake Balkash, Tarim, Lake Lop-nor. The range extended as far as east and north as the Altai and southern Ob basin (Ellerman & Morrison-Scott 1951; Mazak 1965; Perry 1964; Pocock 1929; Schaller 1967). Number in captivity: none.

The coloured plate shows E. Tichmeniev's painting 'The Struggle of Semiretshensk Cossacks against the Tiger near the River Ili in the Year 1892'.

ACKNOWLEDGEMENT

I wish to express my sincere thanks to Prof. Dr. A. A. Sludskyi, Director, Institute of Zoology, Academy of Sciences of the Kazakh

SSR, Alma-Ata, for sending me the photograph of E. Tichmeniev's painting.

3221 Hohenbuechen 31,
West Germany, G. KIRK
June 22, 1968.

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3. LARGE CUCKOO-SHRIKE AND BLACK-HEADED ORIOLE IN KUTCH

On November 16, I first heard and then saw the Large Cuckoo-Shrike *Coracina novaehollandiae* (Gmelin), at Vijaya Vilas, Mandvi. I came across the bird again on 17-xi-68, but this time it was accompanying a Blackheaded Oriole—*Oriolus xanthornus* (Linnaeus), in immature plumage. The Cuckoo-Shrike, when observed the previous day, was by itself; however, on November 17, it was interesting to watch this bird, in the absence of any companion of its own kind, faithfully following the oriole from one tree-top to another.

This Cuckoo-Shrike utters a distinct, querulous and somewhat parakeet-like call mostly while in flight. Had it not been for these frequent call notes I would most certainly have missed both the birds which (as far as I know) have not been previously met with in Kutch.

Bhuj,
Kutch, M. K. HIMMATSINHJI
December 8, 1968.

4. NEST PROTECTION BY THE INDIAN HOUSE CROW (*CORVUS SPLENDENS* LINNAEUS)

The Indian House Crow is both a solitary and colonial nester. A colony of two to ten or more nests are generally found in trees like the Mango (*Mangifera indica*), Banyan (*Ficus bengalensis*) and Peepal (*Ficus religiosa*). It appears that crows prefer to build nests in colonies. A few pairs may, however, be found to nest solitarily on Coconut (*Cocos nucifera*) trees, cornice of a house, electric pole and the like, near colonies. During the nesting season members of the same colony usually collect nest-material from near the nesting site. Quarrels among them are observed only when different crows (not the mates) happen to spot the same material. During the early phase of the nest-construction they are totally indifferent to the intrusion of the Pied Myna (*Sturnus contra*), Common Myna (*Acridotheres tristis*), Jungle Babbler (*Turdoides striatus*) and a few other smaller birds into their nesting area. Curiously, members of the same colony vigorously attack 'foreign' crows (that is, crows not belonging to the same colony) jointly and defend a certain area around the colony against the intruders.

On 7 April 1965, a colony of five nests was found on a peepul tree situated on the southern bank of the Circular Canal near its confluence with the Hooghly River, North Calcutta. There was another colony consisting of eight nests situated on the northern bank of that canal which is about 35 metres wide. On many an occasion crows nesting on the north bank of the canal alighted near the peepul tree on the south bank in quest of nest-material. On every occasion the crows of the south bank colony that happened to be there lost no time in attacking the intruding crow vigorously. The intruder almost always beat a hasty retreat. In the later part of the nesting season, when the eggs and young were in the nest, one of the mates of each pair of the colony usually perched alert very close to the nest. At that time they were very aggressive to not only the 'foreign' crows, but also to other birds. But no such hostility was found to occur among the crows of the same colony until the nest itself was intruded into by a neighbouring crow. Similar behaviour was also observed during the breeding seasons of 1966 and 1967 in four different colonies at Sinthi, a suburb of Calcutta.

From the above observation it appears that a nesting crow defends a small area around the nest against the intrusion of other crows of the same colony, and a larger area (nearly 30 sq. m.) from the intrusion of 'foreign' crows and other birds.

This interesting aspect of nest-protection by the Indian House Crow has not been mentioned in the earlier works on the subject.

DEPARTMENT OF ZOOLOGY,
UNIVERSITY OF CALCUTTA,
CALCUTTA-19,
July 16, 1968.

S. N. SENGUPTA

5. NEW RECORDS OF BIRDS FROM THE GIR FOREST

During a survey of the Jamwala, Sirwan, Sasan and Jasadhar areas of the Gir forest the following species and subspecies of birds not previously recorded from the Gir were collected.

Taccocua leschenaultii sirkee (J. E. Gray) Sirkeer Cuckoo.

	Wing	Tail	Bill
2 ♀♀	150	215-235	29

Chrysomma sinensis hypoleuca (Franklin) Yelloweyed Babbler.

	Wing	Tail	Bill
1 ♂	65	85	14

Muscicapa parva parva Bechstein Redbreasted Flycatcher.

	Wing	Tail	Bill
1 ♂	69	48	9

The species has not been recorded from the Gir forest, though, Sálim Ali (1954-55) reported its occurrence in Saurashtra.

Muscicapa tickelliae tickelliae (Blyth) Tickell's Blue Flycatcher.

	Wing	Tail	Bill
3 ♂♂	74-76	56-58	13-16
2 ♀♀	67-72	52-54	15

Dicaeum agile agile (Tickell) Thickbilled Flowerpecker.

	Wing	Tail	Bill
1 ♂	62	30	8
1 ♀	60	32	9

Lonchura punctulata punctulata (Linnaeus) Spotted Munia.

	Wing	Tail	Bill
1 ♀	54	35	11

Dharmakumarsinhji (1954) reported the rare occurrence of *Lonchura punctulata* Linnaeus from Saurashtra.

DESERT REGIONAL STATION,
ZOOLOGICAL SURVEY OF INDIA,
JODHPUR, (Raj.),
February 1, 1968.

D. S. MATHUR

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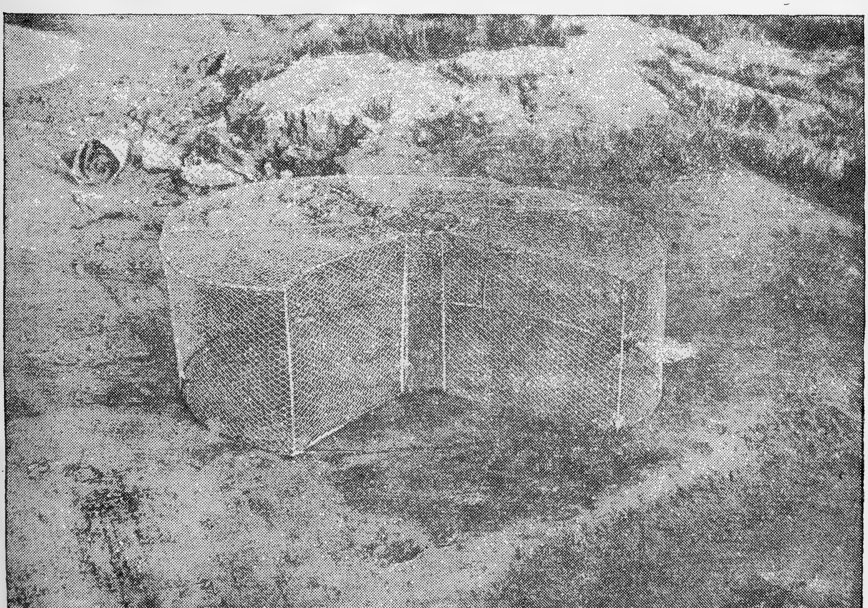
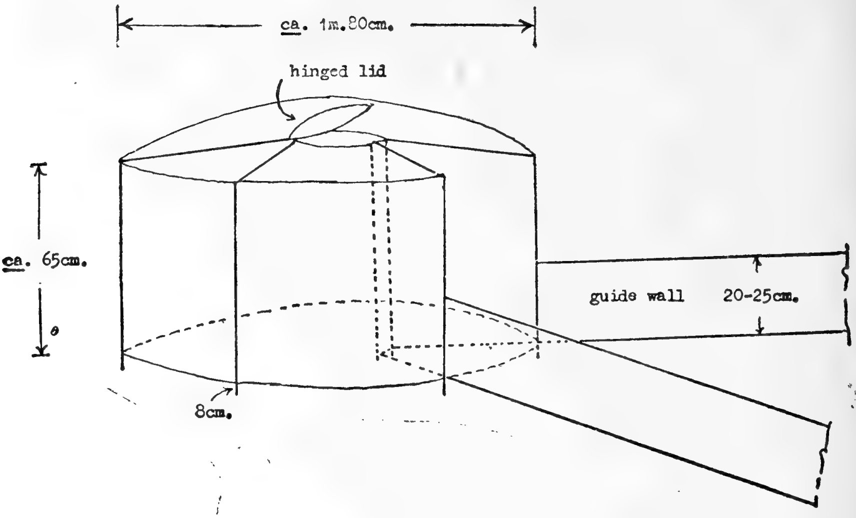
6. FUNNEL-ENTRANCE WIRE CAGE TRAPS

(*With a photograph and two sketches*)

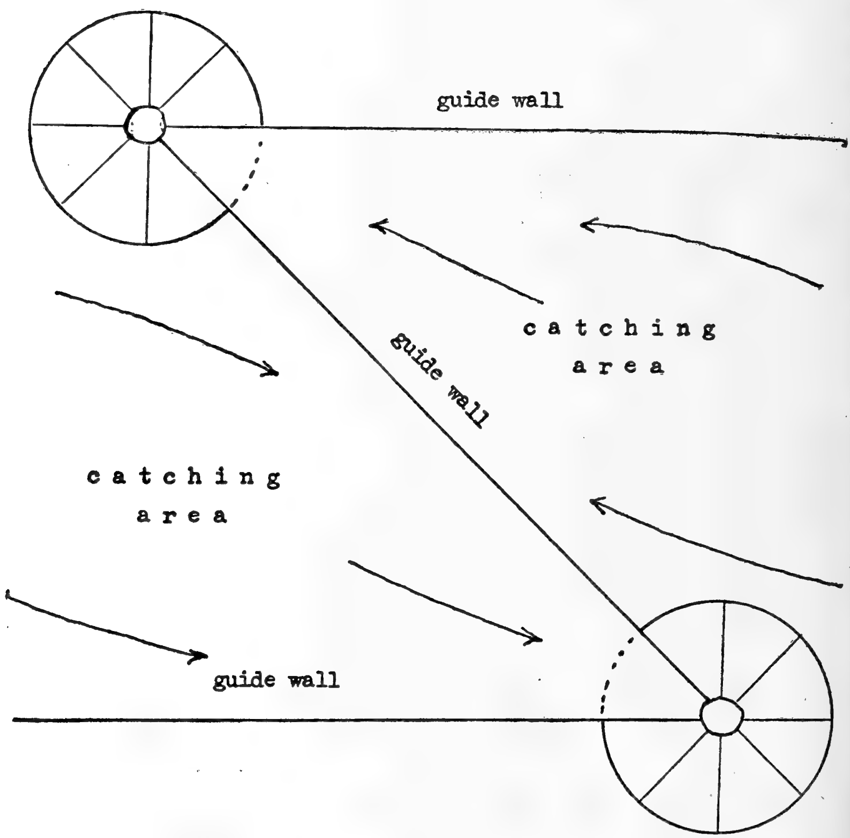
Many variations both in size and design exist of the simple funnel-entrance trap. The one described below is used successfully at the Tour du Valat for catching Larks and Wagtails etc. but especially wading birds up to the size of shank.



The size of the traps is about 1 m. 80 cm. in diameter by about 65 cm. in height. The framework is made of stout galvanized wire



Sketch 1.



Sketch 2.

of 8 mm. thickness. The bottom rail forms a complete circle holding the trap in shape. At the top this rail is cut away at the entrance. Eight vertical members (two forming the entrance) are spaced evenly around the trap and at the top are bent horizontally and meet at the centre to form a circle of about 30 cm. in diameter, where a hinged lid is attached through which the birds can be extracted. These verticals should project 7 or 8 cm. below the bottom rail in order to hold the trap in place on the ground. All joints will have to be welded. The trap is then covered with about 20 mm. mesh, this being attached to the trap by thin wire.

The traps can be placed along the tide-line on the shore or on any muddy areas where birds flock, but care should be taken to avoid placing them actually in the water or where a rising water level may endanger them. They should be embedded into the ground so that no space is left underneath them and so that the short horizontal bar at the entrance (see photograph) does not foul the walk-in. A guide-wall or wing should be attached to each side of the entrance (see sketch 1) about 20 cm. high and 5 or 6 metres long. An ideal set-up is to place the traps in pairs so that the birds can be caught from both sides (see sketch 2). Birds then settling in the area will feed walking along the guide-walls and on finding themselves at the trap are reluctant to turn back and so enter. Of prime importance is the size of the entry. This will of course depend upon the species being trapped, but for such as Dunlin (*Calidris alpinus*) an opening of 4 cm. would be ample, if it is any larger the birds may escape. It often happens that birds force their way in and Lapwings are sometimes caught in traps set for Larks.

The birds caught can be taken out from the trap using a small hand net. When doing so care should be taken not to walk in the entrance. Traps should be visited at least twice a day and when not in use should be either turned over or the entrances thoroughly blocked.

Biological Station of the Tour du Valat,
13, Le Sambuc, A. R. JOHNSON
France,
October 25, 1966.

7. FURTHER OBSERVATIONS ON THE LIMBLESS LIZARD, *OPHISAURUS GRACILIS* (GRAY) FROM SHILLONG, ASSAM

Scarcely any data exists on the biology of the limbless lizard *Ophisaurus gracilis* (Gray), possibly because of lack of opportunities for study in its natural environment. I have earlier noted in this *Journal* (**65**: 233) some preliminary observations on this unique lizard from Shillong. This is a continuation of the observations in the field, and in the laboratory.

It appears that this lizard, has a period of hibernation as could be deduced from the fact that while several individuals were collected from May to October, in the same collecting localities, notwithstanding much painstaking search, no specimens were seen after October until next May.

Specimens in captivity in the laboratory were indifferent to small insects and spiders but earthworms (*Entyphaeus manipurensis* Steph.) were taken avidly. They fed only at night. They avoided daylight on the cage-floor and remained in hiding until it was dark.

A gravid female was collected on 23 June, 1968, and kept under careful observation. A month later on the morning of 22 July, 1968, she presented a clutch of four eggs (which she must have laid during the previous night), and added a fifth egg on the night of 23 July, 1968. The eggs were ellipsoidal, white, measuring 18·00 to 21·00 mm. in length, 10·00 to 11·00 mm. in width and weighing from 1·00 to 1·50 gm. June, July appear to be the breeding months of the limbless lizard in Shillong.

ACKNOWLEDGEMENT

The author wishes to express his gratitude to Dr. A. S. Rao, Regional Botanist, Botanical Survey of India, Shillong, for kindly going through this note and offering valuable suggestions.

ZOOLOGICAL SURVEY OF INDIA,
EASTERN REGIONAL STATION,
SHILLONG-4, ASSAM,
October 31, 1968.

B. K. TIKADER

8. EXTENSION OF RANGE OF COPPERHEAD SNAKE, *ELAPHE RADIATA* SCHLEGEL (OPHIDIA: COLUBRIDAE) TO DOON VALLEY AND DOON SIWALIKS

During studies on snakes of the District Dehra Dun and the Doon Siwaliks I identified two specimens of *Elaphe radiata* Schlegel from Doon Valley and from Doon Siwaliks in the collections of this Regional Station. So far the species has never been recorded from north-western India. The specimens are:

Material: 1 Adult ♂, Regd. No. V 490, from Dhool Kot Forest, Jhajra Forest Range, Dehra Dun Forest Division, District Dehra Dun, collected on 22 March, 1967, by Shri Attar Singh. Snout to vent 1652 mm. Tail 405 mm.

1 Adult ♂, Regd. No. V 411, from Mohund Forest (Doon Siwaliks Hill), Mohund Forest Range, Saharanpur Forest Division, District Saharanpur, collected on 7 Nov. 1964, by Shri T. D. Soota. Snout to vent 1656 mm. Tail 405 mm.

Smith (FAUNA OF BRITISH INDIA. Reptilia & Amphibia 3) has given the range of this species as 'from Orissa (Cuttack) and the Eastern Himalayas (Sikkim) to South China and through whole of the Indo-Chinese subregion to the Malay Archipelago'. The present record of the species from Doon Valley and Doon Siwaliks considerably extends the Western range of the species. In Nepal it is recorded from Arun River Valley, Eastern Nepal and Hitaura, Central Nepal (Swan & Leviton 1962)[1].

I thank Dr. Asket Singh, Officer-in-charge of this Regional Station, for providing me facilities.

ASSISTANT ZOOLOGIST,
NORTHERN REGIONAL STATION,
ZOOLOGICAL SURVEY OF INDIA,
DEHRA DUN,
R. K. BHATNAGAR
December 13, 1967.

9. SNAKE COLLECTION DATA IN AN AREA NEAR BOMBAY

The following is a listing of species of snakes collected on or near Ghodbunder Road, a stretch connecting Thana and Borivli, about 35 miles out of Bombay. The terrain is mostly hilly, with cultivated areas (paddy) and mango groves broken up by areas of forest sometimes quite dense. Besides a fairly heavy snake population, the area

[1] SWAN, LAWRENCE W. & LEVITON, ALAN E. (1962): The herpetology of Nepal: A history, checklist and Zoogeographical analysis of the Herpetofauna. *Proc. California Acad. Sci.* **33** (6): 103-147.

supports reptiles such as monitors (*Varanus monitor*) which are common in rocky areas, geckos, skinks, 'bloodsuckers', and chameleons in large numbers. Some of the mammals are leopards, wild pig, deer, jackals and hares. Birds also abound, and on the higher forested hills peacocks, junglefowl, hornbills, racket-tailed drongos, paradise flycatchers, orioles, etc. can be heard and seen.

Under 'Remarks', DOR refers to specimens found 'dead on road', as valuable information of the occurrence of various species can be obtained by road collecting. The notation 'house' refers to snakes collected from village houses and huts. The collection period was from August, through December, 1968.

Date	Species	Length (mm.)	Remarks
Aug. 25	*Lycodon aulicus*	310	our house, PM
28	*Ptyas mucosus*	1525	our garden, afternoon
	,, ,,	1830	,, ,, ,,
	Vipera russelli	915	old ruins (escaped)
Sept. 13	*Bungarus caeruleus*	1120	fell into well
20	*Ahaetulla tristis*	1200	our garden, morning
23	,, ,,	990	,, ,, afternoon
29	*Naja naja*	520	quarry, afternoon
Oct. 8	*Uropeltis macrolepis*	250	road, early AM
11	*Boiga ceylonensis*	900	road, PM after rain
	Natrix piscator	620	,, ,, ,, ,,
	,, ,,	750	,, ,, ,, ,,
12	*Ahaetulla tristis*	1040	open field, AM
	,, ,,	1070	fell into well
	Natrix piscator	760	house
13	*Cerberus rhynchops*	720	Ghodbunder Creek
20	*Ptyas mucosus*	1520	house
24	*Python molurus*	1900	DOR
	Gerardia prevostiana	580	paddy drainage, PM
	Natrix piscator	600	,, ,, ,,
	,, ,,	220	,, ,, ,,
	Cerberus rhynchops	600	,, ,, ,,
	,, ,,	420	,, ,, ,,
26	,, ,,	180	,, ,, ,,
	,, ,,	450	,, ,, ,,
	,, ,,	880	,, ,, ,,
	,, ,,	400	,, ,, ,,
	Natrix piscator	950	,, ,, ,,
	,, ,,	620	,, ,, ,,
	Gerardia prevostiana	525	,, ,, ,,
28	*Ptyas mucosus*	2100	house, afternoon
	Lycodon aulicus	290	our house, PM
Nov. 1	(3) *Trimeresurus malabaricus*	250-350	DOR, PM
	Cerberus rhynchops	400	paddy drainage, PM
	Natrix piscator	480	,, ,,

Date		Species	Length (mm.)	Remarks
Nov.	2	*Ptyas mucosus*	1800	our garage, afternoon
		Trimeresurus malabaricus	250	road, PM
	4	(4) *Cerberus rhynchops*	300-800	near Ghodbunder Creek PM
	7	*Trimeresurus malabaricus*	280	road, PM
		Lycodon aulicus	250	our house, PM
	8	*Natrix piscator*	280	our garden, ,,
	12	(3) *Cerberus rhynchops*	300-400	paddy drainage
		(2) *Natrix piscator*	200, 350	,, ,,
	16	(2) *Ptyas mucosus*	2090, 2200	house, quarry, afternoon
		Gerardia prevostiana	280	fisherwoman's basket
	18	*Vipera russelli*	900	DOR
	19	*Cerberus rhynchops*	440	paddy drainage, PM
		Natrix piscator	300	,, ,,
		Eryx conicus	580	our garage
	22	*Naja naja*	1500	rat hole under tree
		Cerberus rhynchops	390	paddy drainage, PM
	24	*Ptyas mucosus*	300	house, afternoon
Dec.	1	*Naja naja*	1370	house, AM
	2	*Ptyas mucosus*	900	road, afternoon
	5	,, ,,	2150	house, ,,
	6	*Ahaetulla tristis*	760	,, ,,
	7	*Ptyas mucosus*	1050	up under lorry
	8	,, ,,	2200	house, afternoon
	9	*Natrix piscator*	620	pond, PM
	10	*Vipera russelli*	1070	rat hole, AM
		Ptyas mucosus	2600	field, afternoon
	12	(2) ,, ,,	1500, 600	rat hole, noon ; house
		(2) *Ahaetulla tristis*	1200, 460	our house, tree
	13	*Ptyas mucosus*	2300	house, afternoon
		Naja naja	1180	,, ,,
		Ahaetulla tristis	610	,, ,,
	16	*Oligodon arnensis*	530	DOR
	20	*Eryx conicus*	350	,,
	23	*Naja naja*	900	,,
		Trimeresurus malabaricus	790	,,
	25	*Ptyas mucosus*	1560	road, AM

Note : DOR *Natrix piscator* were common, especially during the rains. I have not listed these.

C/o Chattopadhyaya,
Chateau Marine No. 6,
Marine Drive,
Bombay,
January, 1969.

ROMULUS WHITAKER

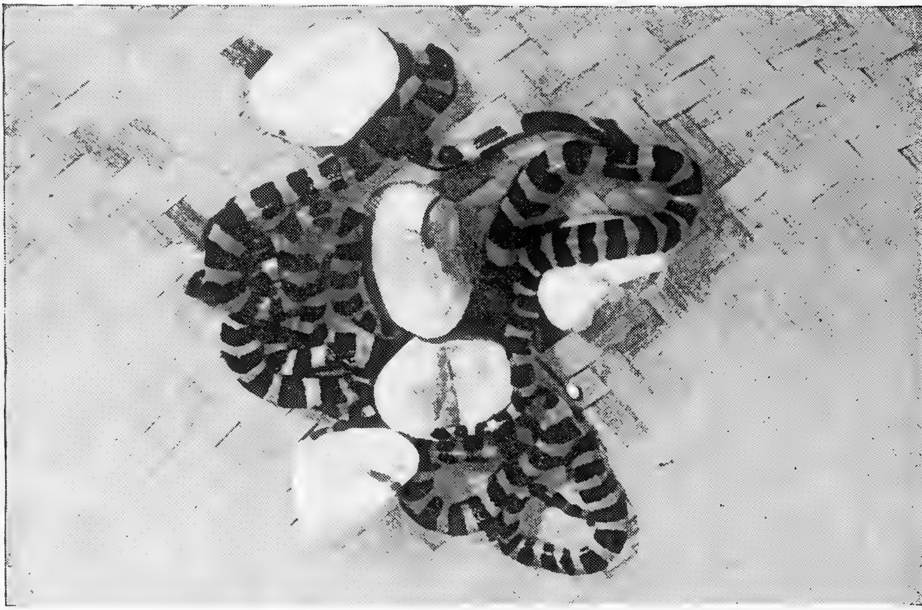
10. THE DOG-FACED WATERSNAKE (*CERBERUS RHYNCHOPS*) IN THE BOMBAY AREA AND NOTES ON ITS HABITS

The complete and usually accurate zoological author, Malcolm A. Smith, states that *Cerberus rhynchops* 'is a comparatively rare species on Indian coasts' (FAUNA OF BRITISH INDIA 3, 1943). A minimal amount of exploring the paddy drainage of creeks such as Bassein, Thana and Malad Creeks around Bombay indicates that actually this may be the most common aquatic snake next to *Natrix piscator* in this area. Below is given a sample one month collection period, October 24 to November 24. Occurring at the end of the monsoon, this is a time of increased snake activity. They are to be found at all times of the year, but most commonly from July through November. No special efforts was made to obtain this species, they were taken while doing general reptile and amphibian collection at night. *Cerberus* are sluggish and easy to capture, rarely attempting to bite. Bites are superficial and non-toxic though other rear-fanged species such as *Boiga* and *Dryophis* may cause some irritation. They concentrate around fish traps and small streams draining into the brackish creeks, and are found many miles from any salt-water. Reported by herpetological authors to be mainly fish-eaters, captive specimens feed well on frogs also, swallowing the prey alive often holding it for 10-15 minutes possibly for venom to take effect.

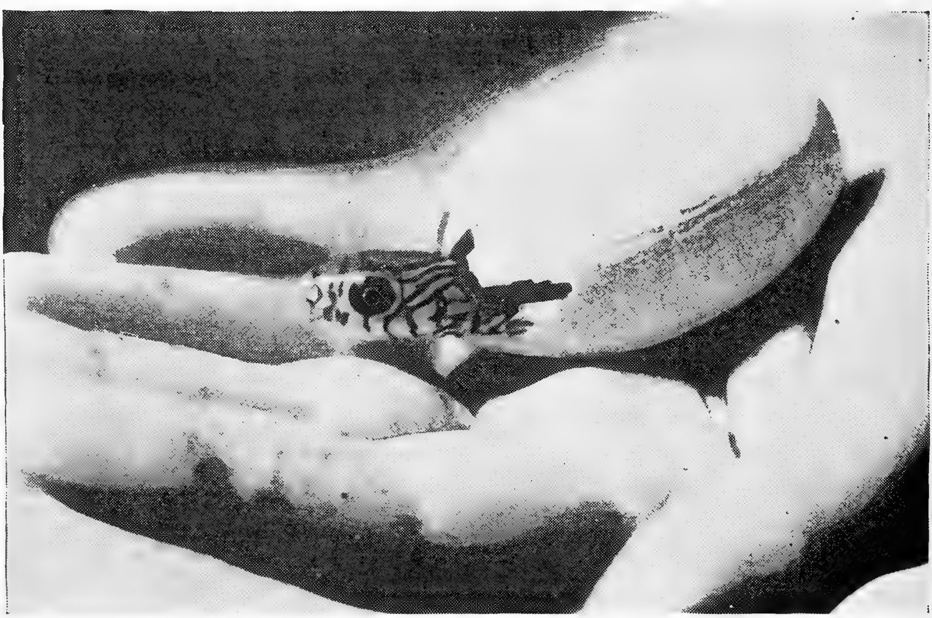
Date	Species	Length (mm.)		
Oct. 24	*Cerberus rhynchops*	600	smallest :	180 mm.
	,, ,,	420	Largest :	880 mm.
,, 26	,, ,,	180	Average:	440
	,, ,,	450		
	,, ,,	880	10 males	
	,, ,,	400	6 females	
Nov. 1	,, ,,	400		
,, 4	,, ,,	810		
	,, ,,	350		
	,, ,,	340		
	,, ,,	300		
,, 12	,, ,,	320		
	,, ,,	300		
	,, ,,	410		
,, 19	,, ,,	440		
,, 24	,, ,,	390		

C/o CHATTOPADHYAYA,
CHATEAU MARINE No. 6,
MARINE DRIVE,
BOMBAY,
November, 1968.

ROMULUS WHITAKER



A litter of five *Bungarus fasciatus*.



Ptyas mucosus hatching.

11. THE HATCHING OF SNAKE EGGS

(*With a plate*)

Most species of Indian snakes deposit eggs before or during the monsoon, thus meeting the moisture requirements of the eggs. Snakes in the wild choose rotted wood, leaves, empty mammal burrows, vacant ant nests, and so on for their egg-laying sites. The eggs have to remain warm and moist, so no doubt many eggs become spoiled in the wild by fungi as has been observed in 'captive' ones. Sometimes the eggs are infertile, or only some fertile. Digging predators with a preference for eggs such as the lizards *Varanus* and certain mammals take a heavy toll of snake eggs. Only a few species of snakes make any effort to protect and incubate their eggs, including the Indian Python (*Python molurus*), and the King Cobra (*Ophiophagus hannah*). Some species lay only a few eggs whereas *Python molurus* has been observed to lay over a hundred eggs in a single clutch.

Snake eggs may be found in the wild at an unknown time in their developmental period or be laid by a captive specimen and incubated, both clutches can be hatched successfully. The most convenient container is a glass aquarium. If not that, a large tin or wooden box may be used, but in the latter case do not allow the eggs to touch the tin or wooden sides. Through trying many incubating materials, one comes to the conclusion that the simplest and best is a bedding of bits of newspaper. Make a thick layer of crumbled $\frac{1}{2}''$ square pieces of newspaper at the bottom of the container. If the eggs are firmly stuck together place them in that way, if they are separate, or easily separated (do not rip them apart as the leathery shell may tear), place them so they are not touching one another and cover with another thick layer of newspaper scraps. Dampen the entire lot with clean, room-temperature water by sprinkling and maintain this dampness for the duration of the incubatory period. Do not soak the eggs as they absorb water by osmosis, and if too much is absorbed the embryo may die. If the eggs become dented then they are too dry, but this doesn't necessarily mean that the embryo has died. If the eggs remain rounded and full, and appear to be getting larger this is a good indication that the embryo is healthy and growing. Even dented, discoloured eggs may have a live embryo inside, however, eggs should be kept until it is evident that they are infertile or spoiled. The eggs should be observed for the first week or two to see that they are getting the proper amount of moisture, after that period, and when experience is gained, it is only necessary to check them every few days.

During the monsoon, when the relative humidity is high, the moisture of the incubating material will be retained for three or four days or more. Rather than a cover for the container, it is convenient and protective to insert the container in a muslin bag like a pillow case and tie a knot at the open end. This allows ventilation, reduces chances of fungus, and prevents flies (which will lay their eggs on the snake eggs) from entering. The newspaper scraps should be changed every twenty days, or if any signs of fungus appear which will soon spread to the whole lot. Choose a spot for the container which will receive the natural warmth of the day (a couple of hours of early or late direct sunlight) and coolness of the night. The eggs of one clutch hatch over a period of a week or more, but more usually within one or two days. Below are given average incubation times for some common Indian snakes. It has been observed that hatching time for 'artificially' incubated python eggs (and probably other species, depending mostly on incubating procedure) may be twenty days or more later than the average. It would be useful to compile more information on hatching times for 'captive eggs'.

Naja naja ssp. (Cobras)		70 days
Bungarus caeruleus	(Common Krait)	65 days
Bungarus fasciatus	(Banded Krait)	60 days
Python molurus	(Indian Python)	70 days plus (variable figures)
Ptyas mucosus	(Rat Snake)	60 days
Ahaetulla tristis	(Bronze-back)	60 days

C/o CHATTOPADHYAYA,
CHATEAU MARINE No. 6,
MARINE DRIVE,
BOMBAY,
December 6, 1968.

ROMULUS WHITAKER

12. SEXUAL DIMORPHISM IN COLORATION AMONG BAND FISHES OF THE FAMILY CEPOLIDAE

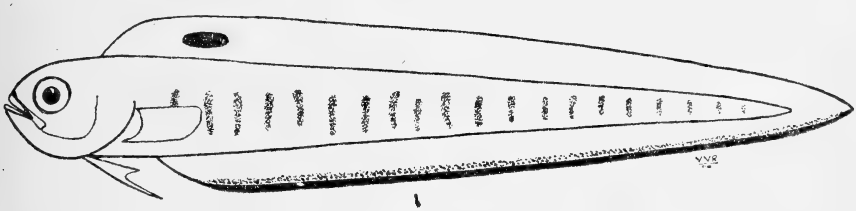
(With two text-figures)

Two species of band fishes, *Acanthocepola limbata* (Cuv. & Val.) and *Cepola abbreviata* (Cuv. & Val.) were collected from Visakhapatnam coast during April, 1964. Both species occurred together and were present in the catches of boat-seines operated within half a mile from the shore and trawlers operated below a depth of 20 fathoms from March to May in considerable numbers after which they gradually disappeared by the middle of July. The period of their occurrence roughly corresponds to the upwelling that takes place in the coastal waters.

Both are brightly coloured. It is interesting to note that while there is a gradual brightening of colour with growth in both species, sexual dimorphism is exhibited only in the colour pattern of anal fins. However, these differences are not evident in small specimens. Earlier colour descriptions of these species are neither full nor do they record sexual dimorphism. Detailed descriptions of colour of fresh specimens of the two species are given below.

Acanthocepola limbata (Fig. 1)

Specimens between 100 and 120 mm. light orange-red with minute black dots all over body especially towards bases of dorsal and anal fins; head darker, eyes orange. Dorsal, anal and caudal fins, dark grey, dorsal with a black oval spot between eighth and fifteenth rays —hence known as the spotted band fish. Pectoral and ventral fins



1

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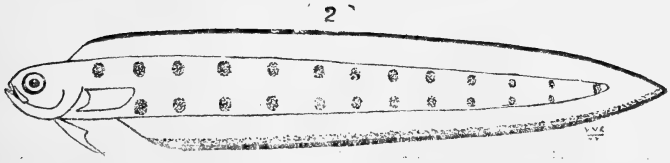

Fig. 1. *Acanthocepola limbata*, male, total length 467 mm. showing scarlet-red and white bands on the anal fin (shown as black and stippled bands respectively in the figure). The yellow bands on the body are shown by stippling.

Fig. 2. *Cepola abbreviata*, male, total length 255 mm. showing orange-red band (shown by stippling in the figure) above the black band on the anal fin. The yellow spots on the body are shown by stippling.

pale yellow. In specimens between 130 and 200 mm. head and body orange, eyes red. About 18 to 20 bright yellow vertical bands appear on body from behind opercle to base of caudal. Dorsal, anal and caudal fins light orange with darker edges, spot on dorsal turns bright red with few melanophores scattered here and there. Pectoral and ventral fins light yellow with orange rays. In specimens above 250 mm. body orange-red, head and upper third of body much darker, eyes bright red. Dorsal in both sexes bright orange with a darker edge, the oval spot turns scarlet-red without any melanophores. Anal in males with a bright scarlet-red band all along the free margin ending in caudal above which is a white band of equal width also ending in caudal; both bands cover the lower third of the fin; upper two-thirds of fin, orange. In females the scarlet-red and white bands are absent and in their place a dark orange band one-third height of the fin is present. Yellow bands on body brighten with growth in both sexes.

Cepola abbreviata (Fig. 2)

In specimens below 150 mm. body pink, head a little darker, eyes red. Dorsal, anal and caudal fins light pink with dark grey edges. Pectoral and ventral fins light yellow; 12 to 14 pairs of yellow oval spots on body from behind opercle to base of caudal, a single spot on base of caudal and one or more in front of it in some specimens. formed by the fusion of lower and upper spots. Specimens above 200 mm. bright pink, head and upper third of body darker, eyes bright red; spots on body turn golden yellow. Dorsal, anal and caudal fins pink in both sexes with a black band one-fifth the height of the fins all along their free margins. Above the black band of anal, males have a bright orange-red band one-fourth the height of the fin, while females have a bright yellow band. Pectoral and ventral fins light yellow with pink rays. Small specimens below 100 mm. grey with pink reflections on the body; head and fins dark grey.

Acknowledgements

I am thankful to Professor P. N. Ganapati for facilities and to CSIR for the award of a Senior Fellowship.

Dept. of Zoology,
Andhra University,
Waltair,
June 10, 1968.

V. VISWESWARA RAO

13. ON CARP FRY MORTALITY DUE TO CYCLOPS ATTACK

During experiments on rearing carp fry in the laboratory, an interesting case of heavy mortality of early fry due to the attack of cyclops was observed. Alikunhi (1952) indicated the role of zooplankton in general on the survival and growth of carp fry, Wilson (1914) observed that *Daphnia pulex* causes mortality of developing fry, and damage to fry (not mortality) by *Mesocyclops edax* is reported by Davis (1959). The present note which describes the extent of damage to and mortality of fry caused by *Mesocyclops* sp., is of particular interest to fish culturists since it is a well-established practice among them to provide the fish fry with abundant supply of their most preferred food, the zooplankton, so as to obtain the best returns.

In the first experiment, ten fry, 5 to 7 mm. in length, were kept in a large petri dish and about 200 cyclops were introduced as food. Within 3 minutes, one fry was fatally wounded and the attacking cyclops was seen firmly attached to the latero-ventral part of the head region of the fry. Even before the dying fry settled at the bottom, a host of other cyclops joined and commenced devouring it. Attack on the other fry followed in quick succession and in a brief period of less than 4 hours, all the ten specimens were killed and eaten leaving only the skeletal parts.

Subsequent observations indicated that percentage of fry mortality is dependent upon the density of cyclops present in the environment. 100 fry, 5 to 7 mm. long, were introduced in a glass aquarium containing 3 litres of water and 0·5 cc. of cyclops were added. Within 1 to 2 minutes, the attack on carp fry commenced and the first mortality occurred within 10 minutes. During the first 30 minutes, 10 fry were killed, followed by another 15 within $2\frac{1}{2}$ hours, thereby causing 25 per cent mortality within 3 hours. But during the succeeding hours, rate of mortality was much less and total of 27 per cent were killed in 24 hours.

A close examination of the mode of attack resulting in mortality of fry and the manner in which cyclops fed on the injured fry clearly showed that the phenomenon is not accidental but is a deliberate activity of cyclops.

Though the concentration of cyclops introduced in the experimental aquaria was very much higher than what is normally found in nursery ponds it is very clear that under favourable conditions *Mesocyclops* causes mortality of carp fry. Predominance of cyclops in nursery ponds could therefore be one of the contributory factors for heavy mortality of fry in them. Some of the other factors, according to Alikunhi (1957) are lack of proper food, presence of predatory insects and fishes and adverse physico-chemical elements of water.

ACKNOWLEDGEMENT

My sincere thanks are due to Dr. M. P. Motwani for his valuable suggestions.

KRISHNA-GODAVARI SURVEY UNIT,
CENTRAL INLAND FISHERIES,
RAJAHMUNDRY, (A.P.),
November 28, 1967.

M. A. V. LAKSHMANAN[1]

14. A NOTE ON THE BREEDING OF *LABEO GONIUS* (HAM.) AT JHANSI (U.P.) IN 1954

With a view to elucidate factors responsible for the breeding of Indian carps in their natural habitat, an investigation was undertaken at Baretaghat nala in the vicinity of River Betwa, a tributary of River Jumna, near Jhansi, for a period of about seven weeks from 1.vii.1954 to 18.viii.1954. During the course of this investigation, a breeding ground of *Labeo gonius* (Ham.) was located in the grassy fields adjacent to Baretaghat nala, about half mile from River Betwa, at 15.00 hours of July 11, 1954. Millions of fertilized carp eggs, later identified as those of *Labeo gonius*, were found scattered over an area of about 30×12 ft. and 1-2 in. deep still water with grassy patches exposed here and there. Majority of the collected eggs hatched out at about 22.00 hours on the day of collection and from data recorded by earlier authors, on the incubation period of *Labeo gonius*, it is presumed that the fish bred during the early hours of the morning of July 11, 1954.

Till the afternoon of July 10, 1954, the nala was completely dry. Towards the evening of that day, there was an abrupt rise in the water level of the River Betwa by 10 feet as a result of which water rushed from the river into the nala flooding the adjoining fields. About this time heavy rain fall occurred at Baretaghat, bringing in torrents of water into the nala from its upper reaches as well as

[1] Present address: Central Inland Fisheries Research Sub-Station, 19, Cantonment Road, Cuttack, Orissa.

from the surrounding area, adding to the inundation caused by the on-rush of water from the river end. At night mature carp were seen ascending from the river to the nala and splashing of water at the place of breeding in the inundated fields was reported by the local people of Baretaghat. The physico-chemical conditions of the river prior to the breeding day (July 10, 1954) and the river and nala subsequent to it (July 11, 1954) were studied. The analysis of the data showed that there was not much difference in the chemical constituents of the two environments (river and nala) on 10 and 11 July, 1954. except in the cases of turbidity, bicarbonate, and chloride contents, the values of which are presented in the table below:—

Physico-chemical factors	Pre-breeding July 10, 1954	Post-breeding July 11, 1954	
	River	River	Nala
Turbidity ..	100	500	195
Bi-carbonate ..	123	142	89
Chloride ..	16	16	8

(Results are expressed in p.p.m.)

Besides the observations on the day of breeding, routine observations on physico-chemical conditions of the river in the pre-breeding period and the river and nala in the post-breeding period were also made and the analysis showed much higher values in temperature, bicarbonate, chloride and silicate in the river water in pre-breeding period. The trace value of carbonate-ion conc. observed in prebreeding period was substituted by free carbon-dioxide during postbreeding period. The physico-chemical conditions did not show any significant changes in the nala and the river water during postbreeding period, excepting on the day of breeding which have been tabled, above.

Remarks:

Diverse opinions have been expressed with regard to the factors responsible for the breeding of Indian Carps as observed in the bundh type of tanks, artificial impoundments, rivers and nalas.

In the present case the breeding followed a chain of events, such as inundation of fields adjoining the nala and heavy local rain probably resulting in the increase of dissolved oxygen and changes, i.e., dilution in the concentration of certain chemical constituents, which appear to have a bearing on breeding.

The breeding of *L. gonius* took place in shallow fields adjoining the nala which were inundated as a result of on-rush of water in the nala caused by an abrupt rise in water level in the river and heavy local rains subsequently. The present and earlier observations on the breeding of carps in inundated fields and in shallow portions of the river suggest that shallow areas which may be located either in fields or in the river bed provide suitable breeding grounds for carps.

The heavy local rain fall which was experienced at Baretaghat soon after the inundation of the fields, adjoining the nala, probably resulted in the increase of dissolved oxygen of the nala water. The dissolved oxygen value of the nala water at the time of location of breeding ground was, however, low (4·4 p.p.m.) which is attributed to high temperature (35·2°C) of nala water, since the day of breeding was sunny. Opinions differ whether increase of dissolved oxygen due to rainfall has some bearing on the breeding of carps.

Sudden changes namely, dilution in the concentration of soluble salts as evidenced by certain chemical constituents such as bicarbonates, chlorides etc., as observed in the present case might be of some significance in stimulating fish to move into the nala to breed. A sharp fall in the bicarbonate and chloride values during breeding and that dilution of chemical substance caused by rains helps breeding has been noted by earlier authors. During the present investigation the bicarbonate and chloride values were 142 p.p.m. and 15 p.p.m. respectively in the river on 11 July. It is reasonable to presume that the bicarbonate and chloride values of the nala water on the 10th July were about the same as those of the river water since water from the river rushed into the nala. The observed lower values of 89 p.p.m. and 8 p.p.m. in bicarbonate and chloride contents respectively in the nala which indicate a fall of soluble salts may be attributed to heavy local rains the previous night. This sudden change from a denser to lighter environment caused by the heavy local shower might have induced the fish to migrate into the nala for breeding.

The authors are indebted to Dr. B. S. Bhimachar and Dr. V. G. Jhingran for kindly going through the typescript critically.

CENTRAL INLAND FISHERIES
RESEARCH STATION,
BARRACKPORE, WEST BENGAL,
April 6, 1968.

P. RAY
S. J. KARAMCHANDANI
R. D. CHAKRABORTY

15. THE OCCURRENCE OF AMPHIOXUS, *BRANCHIOSTOMA INDICUM* (WILLEY) ON THE WEST COAST OF INDIA

On the morning of June 11, 1968, three specimens of Amphioxus, *Branchiostoma indicum* (Willey) were collected at Adatra, near Okha Port, Saurashtra, Gujarat. The specimens were collected from sandy-mud at the low-tide mark.

The collection was made by us, a group of participants in the Summer Institute of Biology for College teachers, at Gujarat University, sponsored by the University Grants Commission, in the course of a field trip to Okha. The specimens are under further investigations.

DEPARTMENT OF BIOLOGY,
ARTS & SCIENCE COLLEGE,
KHOLWAD (DIST. SURAT),
DHRUV DIXIT

DEPARTMENT OF ORGANISMIC BIOLOGY,
UNIVERSITY OF CALIFORNIA,
IRVANE, CALIFORNIA,
GROVER STEPHENS

DEPARTMENT OF BIOLOGY,
SHRI SWAMINARAYAN SCIENCE COLLEGE,
AHMEDABAD,
MEHENDRA PARIKH

February 14, 1969.

16. INCIDENCE OF THE RICE CASE WORM *NYMPHULA DEPUNCTALIS* GUEN., AS A MAJOR PEST IN KERALA

Fletcher (1914) reported the Rice Case Worm *Nymphuia depunctalis* Guen., (Pyralidae, Lepidoptera) as a serious pest of paddy in the plains of S. India. Ayyar (1940) mentions this insect merely as one of the rice pests without indicating its status. During the past three decades the pest has been noted in Kerala occurring as localised patches in fields containing standing water and causing damage of a minor nature. The caterpillars cut the paddy leaves into pieces about ½ inch long, and rolling these into cases, live within. Protruding their heads out, they climb on to the healthy leaves and eat off the green matter leaving white patches as signs of attack. During the present season extensive outbreaks of a very serious nature occurred throughout the *punja* tract in Kuttanad, Kerala, covering 1,86,000 acres in area. According to press reports the damage caused amounted to ten million *paras* (approximately 50,000 tons) of paddy. Examination of several fields showed that the attack was of a large scale. The crop in the infested areas was about 35 days old, and almost every field examined showed signs of severe attack. A careful examination showed that in the near vicinity there were several fields which had been sown earlier and in which crop was in the earhead stage. Plants in these fields showed unmistakable signs of past case-worm attack. It is likely that these mild infestations escaped the notice of the cultivators. As the life history of this insect is rather short, it bred in these fields and the emerging generation of moths found suitable stages of young paddy over wide areas and infested these. In due course, by the concerted effort of the officers of the Agricultural Department, the infestation was brought under control.

DEPARTMENT OF ZOOLOGY,
ST. BERCHMAN'S COLLEGE,
CHANGANACHERRY,
March 7, 1968.

K. V. JOSEPH

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17. PRELIMINARY STUDIES ON THE BIOLOGY OF *NEOCHRYSOCHARIS* SP. (EULOPHIDAE; HYMENOPTERA) A PARASITE OF *PHYTOMYZA ATRICORNIS* MEIGEN

Phytomyza atricornis M., pea leaf miner is a polyphagous pest attacking more than 73 different host plants distributed in 13 different families. A number of parasites of this pest have been reported from various parts of the world. Voukassovitch (1928) recorded *Solenotus viridis* F., and *Chrysocharis elongatus* Thoms. as parasites of this pest in Yugoslavia. Kelsey (1937) recorded 40 to 65 per cent parasitisation of the larvae of *P. atricornis* by a braconid parasite, *Dacnusa areolaris* Nees in New Zealand. Tashkir Ahmad & Gupta (1941) recorded *Solenotus* sp. parasitising the larvae of *P. atricornis* in India. Viggiani (1962) has recorded two eulophid parasites namely *Achrysocharella formosa* Westw., and *Closterocerus trifasciatus* Westw., of this pest in Italy.

During the course of field observations and laboratory rearing a larval eulophid parasite, *Neochrysocharis* sp. was recorded in Gwalior. Its biology, symptoms of injury to host larvae and extent of parasitisation were studied.

The parasitised larva took no food and was sluggish. Its colour changed to blackish as time advanced and it became shrunken.

Biology. The parasite laid one to two eggs within the body of the host. The eggs hatched in 4-5 days and the grubs on hatching fed for 3-4 days inside the body of host bringing about its death at the same time. They then pupated within the body of the host. Adult parasite emerged in 2-3 days. The colour of the pupa was black. A single life cycle was completed in 11-12 days and adults lived for 3 days. The average duration of each period recorded in 5 cases is summarised in Table 1.

TABLE 1

LIFE CYCLE PERIOD AND LONGEVITY OF ADULTS OF *Neochrysocharis* SP.

Month	Incubation period (in days)	Larval period (in days)	Pupal period (in days)	Life cycle period (in days)	Adult longevity (in days)
January 1967	5	4	3	12	3
February 1967	4	4	3	11	3

Extent of parasitism and period of activity. To study its activity and the extent of parasitism, regular collection of the larvae of the pest along with the mined leaves was done and the larvae were examined individually for parasites. The parasite first appeared in the field during the second week of January and continued parasitising the larvae of the pest, up to the end of March 1967. Later on it disappeared. Percentage parasitism was found to be 16 to 30 in February, 44 to 84 in March and was low in January, 2 to 14.

TABLE 2

PERCENTAGE OF PARASITISM OF THE LARVAE OF *P. atricornis* BY *Neochrysocharis* SP.

Date of Collection of the pest	Total number of larvae collected	Number of larvae found parasitised	Percentage
20.I.67	50	1	2
25.I.67	50	4	8
30.I.67	50	7	14
5.II.67	50	8	16
15.II.67	50	9	18
25.II.67	50	15	30
12.III.67	50	22	44
22.III.67	50	33	66
30.III.67	50	42	84

ACKNOWLEDGEMENT

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AGRICULTURE COLLEGE,
GWALIOR, (M.P.),
March 25, 1968.

A. S. KAURAVA
S. C. ODAK
S. V. DHAMDHERE

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18. AN INSTANCE OF THE COPRA BEETLE, *NECROBIA RUFIPES* DE GEER (COLEOPTERA: CLERIDAE) OCCURRING ON WHALE SKELETON

The nearly cosmopolitan copra beetle (also known as the red-legged ham beetle), *Necrobia rufipes* De Geer is known to occur in dried ham, bacon, cheese, bonemeal, fish manure, copra, dried fruits and nuts. A preliminary survey by the authors has shown that this beetle is a very destructive pest attacking stored dried fish along Malabar coast.

In the Department of Zoology, Malabar Christian College, Calicut, the skeleton of a toothed whale showed the presence of a considerable number of this beetle, inhabiting the crevices and spongy parts of the bones. The bones, having been recently prepared, must have still contained some dried animal tissues and fat, thus providing food for the beetles. It is presumed that the bones were infested either before they were brought to the department, or subsequently, as a result of migration of the beetles from a laboratory culture which was at that time being maintained in the department.

Incidentally, a review of literature has shown that there is a report on the occurrence of this beetle on an elephant skeleton.

DEPARTMENT OF ZOOLOGY,
MALABAR CHRISTIAN COLLEGE,
CALICUT-1,
March 7, 1968.

CLEMENT ADOLPH
A. B. SOANS

19. OCCURRENCE OF THE GIANT WATER BUG, *BELOSTOMA INDICUM* LEP. & SERV., IN KHASI HILLS

Recently, on 24 November 1967, we collected a specimen, *Belostoma indicum*, from a side stream of the Umiam River, near Barapani (3,500 ft.) in the Khasi Hills. The specimen agrees with published descriptions of the species except that its underside is greenish instead of being brownish. Length 74·5 mm. This appears to be the first record of this species from eastern India, though the species is known from south and west India and from countries to the east of India.

ZOOLOGICAL SURVEY OF INDIA,
EASTERN REGIONAL STATION, R. K. VARSHNEY
SHILLONG-4, S. BISWAS
December 15, 1967.

20. ON THE HOLOTHUROIDEA (ECHINODERMATA) OF THE GULF OF KUTCH

This paper gives a brief account of the Holothuroid Echinoderms of the Gulf of Kutch. The material for the study was collected from the intertidal zone of Okha, Adatra, Beyt Balapur, Poshitra and Dona Reef and dredged off Pirotan Island, at four to seven metres depth, during 1966 to 1968.

The collection represents six species, belonging to four genera and three families. Of these, *Holothuria ocellata* is a new record to the Indian coast and *Acaudina molpadioides* and *Thyone sacella* are recorded for the first time from the west coast of India.

Family MOLPADIDAE

Genus *ACAUDINA* Clark

Acaudina molpadioides (Semper).

Flesh coloured with golden spots when alive; preserved specimens dull brown; lying fully exposed on mud.

Family DENDROCHIROTAE

Genus *ACTINOCUCUMIS* Ludwig

Actinocumis typica Ludwig.

Colour in life dull to deep grey; collected from rock crevices, sometimes rocks had to be broken to remove closely adhering animals; off

Pirotan, specimens were obtained from a bottom of sandy mud mixed with dead bivalve shells.

Genus *THYONE* Oken

Thyone sacella (Stolus) Selenka.

Colour in life dark brown with deep violet crown of tentacles; collected from crevices of rocks.

Genus *HOLOTHURIA* Linnaeus

Holothuria ocellata Jaeger.

Colour in life purplish brown to black; found in sandy pools.

Holothuria pardalis Selenka.

Colour in life varies from dark brown to purplish with 9-10 black spots; collected from beneath or inside crevices of stones.

Holothuria ocellata Jaeger.

Colour in life deep grey with six to seven dark ocelli on dorsal side, white rings around papillae on dorso-ventral margin seen in some cases; collected from within or underneath stones in gravel mud, dredged from sandy mud mixed with dead bivalve shells.

Acknowledgements

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Marine Biological Research Station,
Port Okha,
November 14, 1968.

P. GOPALAKRISHNAN

21. PARASITISM OF MALES OF *ORNITHODOROS* (*PAVLOVSKYELLA*) *THOLOZANI* VAR. *CROSSI* (LABOULENE & MEGNIN 1882) ARGASIDAE: IXODOIDEA, ON FED NYMPHS AND FEMALES OF THE SAME SPECIES

(*With two photographs*)

In Ixodidae the males of *Ixodes tenuirostris, I. holocyclus* and *Hyalomma detritum* have been observed to parasitize fed females of their own species (Nuttal & Warburton 1911; Moorhouse 1966; Usakov 1961). Sergent (1930) found that the nymphs of *Hyalomma mauritanicum* were cannibalistic. Amongst Argasidae a similar phenomenon has been noticed in *Argas persicus* (Nikitina 1959) *Ornithodoros verrucosus* and *O. papillipes* (Shrinanik 1939; Petrishceva 1947; as quoted by Nikitina 1959). Rao & Kalra (1949) observed unfed larvae of *O. tholozani* feeding on fed ones of the same species when both were kept in the same tube, and a similar case of parasitism was also observed by them twice with the nymphs.

The purpose of the present communication is to record the observations on the parasitism by male *Ornithodoros tholozani* on fed nymphs and females of the same species in the colony maintained in this laboratory.

The colony was initiated with the ticks collected from hilly region of Rajori in Jammu, India, on March 20, 1967. All the stages of tick were fed on rabbits once in 15 to 20 days. When the hungry ticks were released on the rabbit for feeding, the earlier instar nymphs were the first to attach on the host. They generally attached within five minutes of releasing. Later instar nymphs and females kept on crawling over the skin of rabbit for 10 to 15 minutes before attaching. It generally took 20 to 30 minutes for all the instars of nymphs and females to complete the blood meal.

The males were not observed to feed directly on rabbit. They invariably attached themselves to fed nymphs or fed females. Generally fully engorged free nymphs and females were sought by the males, but sometimes the nymphs and females still attached to the host in the act of feeding were attacked. The males crawled over them and pierced the integument of their dorsal surface with their mouth parts (Fig. 1). The males took about twenty minutes to become fully engorged with the blood of their 'hosts'. After the detachment of the feeding males the nymphs or females appeared much smaller, with their integument shrivelled up as the result of loss of ingested blood. A wound was also observed at the site of feeding, and generally a

Fig. 1. The male *O. tholozani* attached to a nymph for feeding.

Fig. 2. Dorsal integument of the nymph with a drop of blood oozing out from the wound made by the male while feeding.

drop of blood or haemolymph was found oozing out from the wound (Fig. 2).

It had been pointed out by Nikitina (1959) and Rehacek (1965) that this type of homoparasitism in ticks might be of some importance in maintaining the pathogen in nature, by transmitting it among themselves, with the bite of the males. Though *O. tholozani* has been known to be the vector of spirochaetes causing relapsing fever in Kashmir (Rao & Kalra, 1949), it is difficult to say that this phenomenon of homoparasitism in this species of ticks has any epidemiological significance. More experimental evidence, however, is needed to make a definite statement in this direction.

ACKNOWLEDGEMENT

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VIRUS RESEARCH CENTRE,[1]
POONA,
December 20, 1968.

V. K. M. BHAT

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22. A RECORD OF PREDATORY MITE, *BOCHARTIA* SP. (ERYTHRAEIDAE; ACARINA) ON *CLAVIGRALLA GIBBOSA* SPINOLA

Clavigralla gibbosa S., popularly known as Tur-pod Bug, a minor pest of *Cajanus cajan* L. assumed serious status in Madhya Pradesh. In nature this pest is kept under control by parasites and predators. Lefroy (1909) and Misra (1924) have reported some chalcid egg

[1] The Virus Research Centre is maintained by the Indian Council of Medical Research. The Centre also receives a grant (3×4307) of the PL 480 Funds from the National Institute of Health, U.S.A.

parasites of *Clavigralla gibbosa*. Usman & Puttarudriah (1955) and Bindra (1963) have recorded *Hadronotus fuviventris* C., and *H. antestiae* Dodd. as egg parasites of *C. gibbosa* at Bangalore and Jabalpur respectively. There seems to be no record of predatory mites on *C. gibbosa* so far.

We noted mites, *Bochartia* sp. which are reddish in colour, preying on the nymphs and adults of *C. gibbosa*. These were attached to any part of the body of the host except on legs and antennae.

The adult mite is oval with large number of setae. A shallow furrow separates the propodosoma from hysterosoma. A pair of eyes present. Legs long, slender, with hair-like setae, six-segmented, tarsi with two claws, but no empodium. Four pairs of legs are present in case of adult; first pair small, present near the head, while others are long. The nymph has three pairs of legs.

The chelicerae are unsegmented. Adults are free-living predators. Both nymphs and adults are attached to the body of the bug in all its stages. On an average the adult mite measures 1·411×0·846 mm.

Percentage of predatory mite attack.

In order to work out the percentage predatism caused by the mite in the field, random samples were taken and percentage of attacked individuals to the total was worked out. Data are summarised below.

Date of sample	Number of individuals in a sample	Number attacked by mite	Percentage
20-ii-65	34	7	20·58
22-ii-65	68	3	4·41
24-ii-65	15	1	6·66
11-iii-65	20	2	10·00

The authors are grateful to the Director, Commonwealth Institute of Entomology, London, for identifying the mite.

Department of Entomology,
Jawaharlal Nehru Krishi Vishwa Vidyalaya,
Jabalpur,
Sehore Campus,

R. R. RAWAT
K. N. KAPOOR
U. S. MISRA
S. V. DHAMDHERE

December 14, 1967.

References

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23. SOME MORE PLANTS FROM PAVAGADH HILL, NEAR BARODA

Since the publication of the flora of Pavagadh hill near Baroda (Chavan & Oza 1966), additions have been made to it by Shah & Inamdar (*J. Bombay nat. Hist. Soc.* **62**: 279-284, 1965) and (Chavan, Bedi & Sabnis ibid **63**: 786, 1966). We have been collecting plants from Pavagadh every year in August and September since 1964. In 1968 the collections were made in March-May. During the course of the study it was found that (*a*) information on some of the common trees like *Holoptelea integrifolia* Planch., *Miliusa tomentosa* Sinclair etc. is missing; *Sauromatum guttatum* Schott is so common, profusely flowering in March-April, that it can hardly be overlooked; (*b*) there are several plants in our collections which are not reported earlier; (*c*) in some cases our observations differ from the published data. The present note is, therefore, prepared to supplement the existing information on the flora of Pavagadh. All the plants enumerated in this paper are deposited in the herbarium of the Botany Department, Sardar Patel University, Vallabh Vidyanagar. For each plant the author's (Shah) collection numbers and flowering time are given in brackets. Those marked with an asterisk are given by Chavan & Oza.

ANNONACEAE

Miliusa tomentosa (Roxb.) Sinclair.

Common. Flowers greenish to reddish-brown. (March-April; 14495, 14517)

CRUCIFERAE

Rorippa indica (L.) Hiern.

Common in moist ground along margins of a pond on way to Machi. Flowers yellow. (March; 14516)

FLACOURTIACEAE

Casearia graveolens Dalz.

Rare in the forest near Machi. Flowers greenish-yellow. (March-April; 14507)

MALVACEAE

Thespesia populnea Soland. ex Corr.

Only one tree, planted near Machi. Flowers large sulphur-yellow. (September; 13078)

Burseraceae

Boswellia serrata Roxb. ex Colebr.

Common at the foot of the hill; a few trees also seen in the forest in the vicinity of Machi. Flowers creamy-white. The bark and the trigonous fruits are distinctive. (March-April; 11700 A)

* **Garuga pinnata** Roxb.

Though Chavan & Oza state that this is a common tree all over the hill, we have been able to locate only 2-3 trees at the foot of the hill near the bus stand, all profusely flowering. The plant is quite conspicuous by the masses of creamy-white or pale yellow flowers at the ends of leafless branches. (Noted on 10-iii-1968)

Celastraceae

* **Maytenus emarginatus** (Willd.) D. Hou

Rare, only one plant seen in fruit. (March; 14499). Chavan & Oza list it under *M. senegalensis* (Lamk.) Exell. Ding Hou (*Fl. Males.* **6**(2): 241, 1962) has shown that *Celastrus senegalensis* Lamk., on which *M. senegalensis* Exell is based, is an African plant quite distinct from the Asian-Malaysian *M. emarginatus* (Willd.) D. Hou.

Rhamnaceae

Zizyphus horrida Roth

A bushy shrub. Rare (13077)

Vitaceae

Cissus repanda Vahl

Occasional in the forests on tree trunks along with *Dioscorea bulbifera* L.

Rosaceae

Potentilla supina Linn.

Common in moist ground along margins of a pond on way to Machi, mixed with *Gnaphalium indicum* L., *G. pulvinatum* Del., *Grangea maderaspatana* Poir. and *Polygonum plebeium* R.Br. (March; 14496)

Combretaceae

Anogeissus sericea Brand.

Rare, Flowers yellow, profuse. (March; 14497)

CUCURBITACEAE

Trichosanthes bracteata (Lamk.) Voigt.

Rare along with *Cissus repanda* Vahl. The negro-punctate undersurfaces of the leaves are distinctive. (13094)

COMPOSITAE

Glossocardia bosvallia (L.f.) DC.

Common among short grass during the rainy season. Flowers reddish-brown. (September; 13082)

PERIPLOCACEAE

Hemidesmus indicus (L.) Schultes.

Rare, trailing along open ground near Machi. The leaves are distinctive. (Noted on 10-iii-1968)

EHRETIACEAE

Cordia gharaf (Forsk.) Ehrenb. & Asch.

2-3 trees on edge of a pond on way to Machi. Flowers white or creamy-white with a pinkish tinge. (September; 13076)

Ehretia laevis Roxb.

Rare; only two trees along the edge of a dried up pond at the foot of the hill. Flowers white or pale blue. (March; 14506)

CONVOLVULACEAE

Convolvulus rottlerianus Choisy

An erect slender herb, about 75 cm. tall. Flowers bright rosy-pink. Rare, among grass on hill slopes. (September; 13075)

SCROPHULARIACEAE

* **Lindenbergia muraria** (Roxb.) P. Bruehl

Lindenbergia indica (L.) O.K.; Chavan & Oza, p. 165.

Common on old walls of the Fort. For the nomenclature of this plant see Santapau, FLORA OF KHANDALA (ed. 3) 330, 1967.

Lindernia crustacea (L.) F. Muell.

Common among short grass in the rainy season. (Noted on 3-ix-1968)

VERBENACEAE

Gmelina arborea Roxb.

Rare; One tree seen growing with *Ehretia laevis* Roxb. In the field the red glands on the lower surface of the leaves render the identification easy even in a vegetative condition; the bark is also typical. (Noted on 10-iii-1968)

LABIATAE

Hyptis suaveolens Poit.

Common, in patches, mixed with *Cassia tora* L. along roadside at the foot of the hill. Flowers blue. (Noted on 3-ix-1967)

LORANTHACEAE

* **Dendrophthoë falcata** (L.f.) Etting.

To the lists of hosts cited by Chavan & Oza, we add *Flacourtia indica* Merr., *Helicteres isora* L. and *Terminalia bellirica* Roxb. (Noted on 3-x-1968)

* **Viscum articulatum** Burm. f.
V. nepalense Spr.; Chavan & Oza, p. 202.

Chavan & Oza cite *Randia spinosa* (Thunb.) Blume and *Terminalia crenulata* Roth as the hosts. Since 1964 we have been noting it, along with the previous species, only on *Grewia tiliaefolia* Vahl. For the nomenclature of this plant see Seshagiri Rao in *J. Indian bot. Soc.* **26**: 126, 1957.

EUPHORBIACEAE

* **Putranjiva roxburghii** Wall.

Chavan & Oza (p. 212) listed this plant without exact locality and collection number; further the information on its relative abundance is also lacking. Since we began the botanical exploration of this hill, we have been searching for it in different parts of the forests and on 10-iii-1968, two trees were seen by us in the vegetative condition on the edges of a pond on way to Machi. The leaves are typical. (14153)

ULMACEAE

Holoptelea integrifolia Planch.

ARACEAE

Sauromatum guttatum (Wall.) Schott

Very common and abundant in shaded spots on way to Machi. Spathes reddish-purple. The inflorescence has a bad smell. Flowers profuse in March-April. (14495, 14508)

CYPERACEAE

Cyperus triceps Endl.

Common. (13084)

ACKNOWLEDGEMENTS

We are deeply grateful to The Keeper, Central National Herbarium, Calcutta, for the identification of *Putranjiva roxburghii* Wall. and *Sauromatum guttatum* Schott. Sincere thanks are also due to Dr. R. J. Patel and Shri J. A. Inamdar who have helped in the collection of plants.

DEPARTMENT OF BOTANY,
SARDAR PATEL UNIVERSITY,
VALLABH VIDYANAGAR,
GUJARAT,
June 19, 1968.

J. G. CHOHAN
G. L. SHAH

24. A NOTE ON COMMELINACEAE OF NORTHERN MADHYA PRADESH

Tiwari & Maheswari[1] (1965) worked out the family Commelinaceae of Madhya Pradesh. But Shivpuri, Gwalior, Bhind, Morena, and Datia districts of Northern M.P. are almost unexplored. During intensive exploration in these districts, the author collected some plants, which, so far, have not been reported from Northern M.P., except those marked with an asterisk from Gwalior. Only localities and collection numbers for each plant are given.

Herbarium sheets are deposited in the Botany Department, Government Science College, Gwalior.

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[1] TIWARI, S. D. N. AND MAHESWARI, J. K. (1965) : The Commelinaceae of M.P. *Indian For.* **91** (8) : 580-590.

Enumeration of Species

Commelina diffusa Burm. f.
Harsi J. 618.

C. longifolia Lamk.
Gwalior, Datia, Morena. J. 619.

C. hasskarlii Clarke
Shivpuri, Gwalior, Morena, Bhind. J. 620.

* **C. benghalensis** Linn.
Common throughout the area but abundant in Harsi. J. 621.

C. attenuata Koen. ex Vahl
Harsi, Gwalior. J. 622.

C. forskalii Vahl
Gwalior, Morena, Datia and Bhind. J. 623.

C. kurzii Cl.
Narwar, Shivpuri, Gwalior, Bhind, Morena. J. 624.

* **Murdannia malabarica** (L.) Sant.
Gwalior, Morena, Banmor, Bhind. J. 625.

Cyanotis cristata (L.) D. Don.
Harsi. J. 626.

C. axillaris (L.) Schult. f.
Frequent throughout the area. J. 627.

* **C. fasciculata** (Roth) Schult. f.
Harsi. J. 628.

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Dept. of Botany,
Govt. Science College, J. P. KAUSHIK
Gwalior, (M.P.),
October 23, 1968.

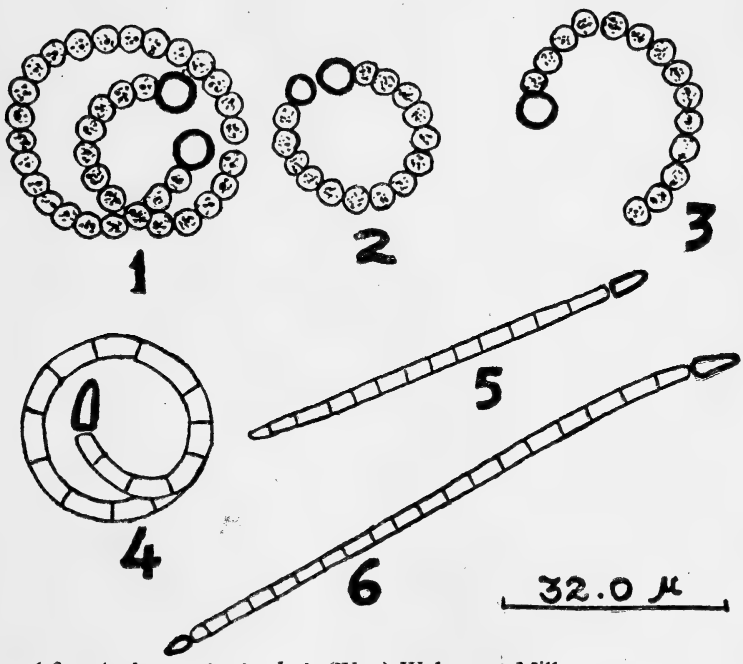
25. THREE LITTLE KNOWN SPECIES OF *ANABAENOPSIS* (WOLOSZ.) MILLER FROM GWALIOR, (M.P.)

(*With six text-figures*)

This paper deals with the description of three species of *Anabaenopsis* (Wolosz.) Miller, which were recently collected by me. *Anabaenopsis circularis* (West) Wolosz. et Miller and *Anabaenopsis raciborskii* Wolosz. are new records for India. *Anabaenopsis tanganyikae* (West) is noted for the first time from Central India.

Anabaenopsis circularis (West) Wolosz. et Miller

Trichomes spirally coiled usually with $\frac{1}{2}$ to $3\frac{1}{2}$ spirals but in some cases up to 7 spirals have been recorded, 3·5-6·6 μ broad; cells spherical and granulated; heterocysts terminal 5·0-8·0 μ broad. (Figs. 1-3.)



Figs. 1-3. *Anabaenopsis circularis* (West) Wolosz. et Miller; Fig. 4. *Anabaenopsis tanganyikae* (West) Wolosz. et Miller; Figs. 5-6. *Anabaenopsis raciborskii* Wolosz.

Anabaenopsis tanganyikae (West) Wolosz. et Miller

Trichomes forming $\frac{1}{2}$ to 1 spiral 3·0-4·5 μ broad, without sheath and unconstricted; cells 5·0-8·5 μ long; heterocysts terminal and bluntly conical 3·0-4·0 μ broad, 5·0-6·8 μ long. Spores are not present. (Fig. 4)

Anabaenopsis raciborskii Wolosz.

Trichomes straight and without sheath 55-180 μ long, 3·0-4·5 μ broad; cells 6·0-7·5 μ long, trichome slightly tapering at one end; heterocysts either at one end or both the ends, conical, 3·0-4·0 μ broad and 4·0-6·5 μ long. Spores could not be observed. (Figs. 5-6)

All the three species were collected together on 4 August 1968 from a roadside pond near Harsi dam forming a thin greenish film on the surface of the water.

The material and slides have been deposited at the Botany Dept., Govt. Science College. Gwalior.

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I express my grateful thanks to Principal Narayan Singh and Prof. T. N. Raghwachar, Head of the Botany Department, Government Science College, Gwalior, for giving encouragement and facilities.

DEPT. OF BOTANY,
GOVT. SCIENCE COLLEGE, D. S. AGARKAR
GWALIOR, (M.P.),
September 20, 1968.

26. NEW PLANT RECORDS FOR BOMBAY, COLLECTED FROM DANGS FOREST, GUJARAT

Urticaceae

Distemon indicum Wedd. Monogr. Urt. 551, t. 20 A, 1911; Hooker, Fl. Brit. India 5:588, 1888; Haines, Bot. Bihar & Orissa 3:858, 1961, reprinted.

An erect or suberect, slender *herb*, 15-35 cm. tall. *Leaves* 1·6-6·7 × 0·9-4 cm., ovate, prominently 3-nerved from the base, distantly dentate, sparsely appressedly pubescent above, hairy on nerves beneath and cobwebby pubescent between, acute, subacute or caudate at apex, rounded or cuneate at base; petioles 0·5-3 cm. long, filiform; stipules 4-6 mm. long, lanceolate with setaceous tip. *Flowers* minute, in 1·5-6·5 cm. long, axillary and terminal spikes. *Achenes* ± 2 mm. long, ovoid, ribbed, brown, sparsely hairy.

Rare. In undergrowth among rocks in the forest at Ahwa (*BS* 2120). This plant may be mistaken for *Pouzolzia zeylanica* Benn. which it resembles in habit and habitat. In the field, however, it can be separated from the latter by the cobwebby-white pubescence between nerves on the lower surface of the leaf and spicate inflorescence.

Flowers and fruits: October.

World distribution: India (Ranchi, Assam, Gujarat), Burma and Java.

CYPERACEAE

Cyperus alutatus Kern in Reinwardtia 1(4): 463-466, t. 1, 1952.

Common, scattered or subgregarious, among grass and on moist ground.

This species is often confused with *C. iria* Linn. but the two species can be distinguished by the following key:

Rachis flexuose, hispid on the angles; spikelets compressed, rectangular; internodes of rachilla 0·6-1 mm. long; glumes (1·75-) 2 mm. long and as much broad, dorsally (5-)7(-9)- nerved; keel spinulose-ciliate; achenes 1·5 mm. long........................ *C. alutatus*

Rachis glabrous; spikelets 1·5-2 mm. broad; internodes of rachilla small (c. 0·5 mm.); glumes 1·2-1·5 mm. long, dorsally 3(-5)-nerved; achenes 1-1·25 mm. long........................ *C. iria*

Fimbristylis podocarpa Nees & Mey ex Nees in Wt. Contrib. Bot. Ind. 98, 1834, p.p. typ.; Nov. Act. Ac. Nat. Cur. 19, Suppl. 1: 77, 1843, p.p.; Clarke, Fl. Brit. Ind. 6: 638, 1893; Kern in Blumea 8: 139, 1955.

Annual *herbs*, 30-45 cm. tall; stem caespitose, glabrous, striate; sheaths 2·5-4 cm. long, glabrous. *Leaves* 20-35 cm. long, linear, acute, serrulate. *Bracts* 3, unequal, largest 5-7 cm. long, leaf-like. *Spikelets* 5-6 × 3-4 mm., ovate, reddish-brown, in simple or compound umbels; peduncles 3-12 mm. long. *Glumes* ± 2·5 × 1·5 mm., cymbiform, glabrous. *Nut* ± 1·5 × 1·15 mm., broadly elliptic to suborbicular, straw-coloured, with a distinct gynophore.

Rare; on moist ground (Ahwa: BS 308; Saputara: BS 308A). It is very similar to *F. dichotoma* (L.) Vahl with which it may be confused but the two species can be identified with the help of the key given below (see Kern, p. 155):

Outer cells of the nut in 5-10 (rarely some more) vertical rows on each face; spikelets 5-10 (-20) × $2\frac{1}{2}$-3(-5) mm.; glumes very broadly ovate to oblong-obovate, 2-3 (-$4\frac{1}{2}$) mm. long; stamens 1-3; anthers $\frac{1}{2}$-1 (-$1\frac{3}{4}$) mm.; styles 2-4 mm. long; nut obovate to broadly obovate, with small gynophore.................. *F. dichstoma*

Outer cells of the nut in 16-24 vertical rows on each face; spikelets ($2\frac{1}{2}$-) 3-4 mm. wide; glumes with strong mid-nerve and several obscure lateral nerves, $3\frac{1}{4}$-$3\frac{1}{2}$ mm. long; stamens 2; anthers about $\frac{3}{4}$ mm.; style $1\frac{1}{4}$-$1\frac{1}{3}$ mm.; nut broadly elliptic to suborbicular, prominently stipilate; gynophore $\frac{1}{3}$-$\frac{1}{2}$ mm. long and wide .... *F. podocarpa*

Flowers and fruits: September.

World distribution: India, Malay Peninsula, Philippines, New Guinea.

Fimbristylis sieberiana Kunth, En. Plant. 2:237, 1837; Kern in Blumea 8:131, 1955. *Fimbristylis ferruginea* var. *sieberiana* (Kunth) Boeck. in Linnaea 37:17, 1817. *Fimbristylis ferruginea* (non Vahl 1806) Decne. in Nouv. Ann. Mus. Hist. Nat. Paris 3:352, 1834.

Herbs, 30-60 cm. tall; stems tufted, deeply ridged, glabrous; sheaths 3·5-7 cm. long, brown, hairy, acute at apex. *Bracts* 3, unequal, largest upto 7 cm. long, leaf-like. *Spikelets* 6-10 mm. long, purplish-brown, conico-ovate. *Glumes* $3 \times 1{\cdot}5$ mm., keeled, finely tomentose in the upper half on dorsal surface. *Nut* $\pm$ $1{\cdot}6 \times 1$ mm., suborbicular, on a distinct gynophore.

Common on moist ground at Mahal (BS 2321). This species closely resembles *F. ferruginea.* It differs mainly by the lowest bract usually overtopping the inflorescence, the very broad glumes densely tomentose in apical part, the broader style, the suborbicular nut with distinct gynophore, the longer leaves, the non-coriaceous lower leaf-sheaths and the usually pilose upper sheaths (excerpt from Dr. Kern's letter No. 1565 of 21-7-1967).

Flowers and fruits: November.

World distribution: India, Lesser Sunda Islands, Philippines, Australia.

The authors wish to thank Dr. J. H. Kern, Risksherbarium, Leiden, and Principal M. B. Raizada, Dehra Dun, for the identification of Cyperaceae plants and *Distemon indicum* respectively.

DEPT. OF BOTANY,
SARDAR PATEL UNIVERSITY,
VALLABH VIDYANAGAR,
November 21, 1968.

G. L. SHAH
B. SURYANARAYANA

27. ON DESMIDS OF GUJARAT

The work on desmids of Gujarat is very meagre. As far as the author is aware only Gupte (1961) and Kamat (1962) have collected a few from Ahmedabad. The author has been surveying the algal flora of Gujarat for the last fifteen years, during which period he has made ample collections. In the present paper fifty-eight desmids from Gujarat are enumerated of which only four have been reported by earlier workers (marked with an asterisk in the text).

The plants enumerated in this paper are in the Department of Botany, Sardar Patel University, Vallabh Vidyanagar.

Family MESOTAENIACEAE

1. **Cylindrocystis obesa** West et West.
River at Balaram near Palanpur.

2. **Gonatozygon brebisonii** De Bary.
Ditches near railway line, Valavao, Dist. Baroda.

3. **G. monotaenium** De Bary.
Ditches on the sides of Anand-Bhalej Road, near Gamadi, Dist. Kaira.

4. **G. monotaenium** var. **pilosellum** Nordst.
Ditches on the sides of Anand-Bhalej Road, near Gamadi, Dist. Kaira.

Family DESMIDIACEAE

5. **Arthrodesmus convergens** Ehrenb.
Ditches on the way to Karamsad, behind Engineering College, Vallabh Vidyanagar.

* 6. **Closterium acerosum** (Schrank) Ehrenb.
Pond, Botanical Garden, V.P. College, Vallabh Vidyanagar.

7. **C. subulatum** (Kütz.) Breb.
Pond on the way to Karamsad, behind Engineering College, Vallabh Vidyanagar.

8. **C. strigosum** Bréb.
Pond on the way to Karamsad, behind Engineering College, Vallabh Vidyanagar.

9. **C. striolatum** Ehrenb.
Pond on the way to Karamsad, behind Engineering College, Vallabh Vidyanagar.

* 10. **C. venus** Kütz.
Ditches behind Engineering College, Vallabh Vidyanagar.

11. **Cosmarium auriculatum** Reinch.
Pools near old water room, Faculty of Science Compound, Baroda; pond on the way to Karamsad, behind Engineering College, Vallabh Vidyanagar.

12. **C. bioculatum** Bréb.
Pools, near old water room, Faculty of Science Compound, Baroda.

13. **C. biretum** Bréb.
Ditches behind Engineering College, Vallabh Vidyanagar.

14. **C. caniculatum** Schm.
Ditches on the sides of Anand-Bhalej Road, near Gamadi, Dist. Kaira.

15. **C. cyclicum** Lund.
Ditches on the way to Bakrol, Vallabh Vidyanagar.

16. **C. galeritum** Nordst.
Pond, Botanical Garden, V. P. College, Vallabh Vidyanagar.

* 17. **C. laeve** Rabenh.
Gangda Pond, Valavao, Dist. Baroda.

18. **C. laeve** var. **aceratum** Scott et Prescott.
Ditches on the sides of Anand-Bhalej Road, near Gamadi, Dist. Kaira.

19. **C. margaritatum** var. **quadrum** Krieger.
Ditches on the sides of Anand-Bhalej Road, near Gamadi, Dist. Kaira.

20. **C. monomazum** Lund.
Pond on the way to Karamsad, behind Engineering College, Vallabh Vidyanagar.

21. **C. phaseolus** Bréb.
Ditches on the sides of Anand-Bhalej Road, near Gamadi, Dist. Kaira.

22. **C. reinchii** Arch.
Pools near old water room, Faculty of Science Compound, Baroda.

23. **C. rectangulum** Reinch.
Pools near old water room, Faculty of Science Compound, Baroda.

24. **C. reniforme** (Ralfs) Arch.
Ditches near railway line, Valavao, Dist. Baroda.

25. **C. subspeciosum** Lund.
Gangda pond, Valavao, Dist. Baroda; pond on the way to Karamsad, behind Engineering College, Vallabh Vidyanagar.

26. **C. subtumidum** Nordst.
Pond on the way to Karamsad, behind Engineering College, Vallabh Vidyanagar.

27. **C. tumidum** Lund.

Pond on the way to Karamsad, behind Engineering College, Vallabh Vidyanagar.

28. **Cosmocladium constrictum** Arch.

Pools near Jaganath Mahadeo, Anand.

29. **Desmidium baileyii** (Ralfs) Nordst.

Ditches on the sides of Anand-Bhalej Road, near Gamadi, Dist. Kaira.

30. **Euastrum elagans** Bréb.

Pond on the way to Karamsad, behind Engineering College, Vallabh Vidyanagar.

31. **E. elagans** var. **pseudoelagans**.

Ditches on the sides of Anand-Bhalej Road, near Gamadi, Dist. Kaira.

32. **E. inusitatum** Prescott.

Ditches on the sides of Anand-Bhalej Road, near Gamadi, Dist. Kaira.

33. **E. luetkemulleri** Du Cell.

Ditches near railway line, Vallabh Vidyanagar; ditches on the sides of Anand-Bhalej Road, near Gamadi, Dist. Kaira.

* 34. **E. spinulosum** Delp.

Pond near Mesari River, Valavao, Dist. Baroda.

35. **E. subhypochondrum** Fritch et Rich.

Ditches on the sides of Anand-Bhalej Road, near Gamadi, Dist. Kaira.

36. **E. sublobatum** Bréb.

Nal Sarovar.

37. **Hyalotheca mucosa** (Dillw.) Ehrenb.

Ditches on the sides of Anand-Bhalej Road, near Gamadi, Dist. Kaira.

38. **Micrasterias tropica** Nordst.

Ditches near railway line, Vallabh Vidyanagar.

39. **Penium** sp.

Pools near Jaria Pond, Anand-Vidyanagar Road, Vallabh Vidyanagar.

40. **Pleurotaenium coronatum** (Bréb.) Ralfs.

Ditches on the sides of the road near railway station, Vallabh Vidyanagar.

41. **Sphaerozosma wallichii** var. **anglicum** West et West.
Ditches on the sides of Anand-Bhalej Road, near Gamadi, Dist. Kaira.

42. **Spondylosium planum** (Wolle) West et West.
Ditches on the sides of Anand-Bhalej Road, near Gamadi, Dist. Kaira.

43. **Staurastrum apiculatum** Bréb.
Ditches on the sides of Anand-Bhalej Road, near Gamadi, Dist. Kaira.

44. **S. clevi** (Wittr.) Roy et Biss.
Ditches near railway line, Vallabh Vidyanagar.

45. **S. cuspidatum** Bréb.
Ditches on the sides of Anand-Bhalej Road, near Gamadi, Dist. Kaira.

46. **S. furcatum** Bréb.
Ditches on the sides of Anand-Bhalej Road, near Gamadi, Dist. Kaira.

47. **S. furcatum** var. **candianum** (Delp.) Cooke.
Ditches on the sides of Anand-Bhalej Road, near Gamadi, Dist. Kaira.

48. **S. lunatum** Ralfs.
Ditches near railway line, Vallabh Vidyanagar.

49. **S. mucronatum** Ralfs.
Ditches on the sides of Anand-Bhalej Road, near Gamadi, Dist. Kaira.

50. **S. polytrichum** Prety.
Pond on the way to Karamsad, behind Engineering College, Vallabh Vidyanagar; ditches on the sides of Anand-Bhalej Road, near Gamadi, Dist. Kaira.

51. **S. pseudosebaldi** var. **simplicus** West.
Pond, Botanical Garden, V. P. College, Vallabh Vidyanagar.

52. **S. setigerum** Cleve.
Ditches near railway line, Vallabh Vidyanagar.

53. **S. striolatum** (Naeg.) Arch.
Ditches on the sides of Anand-Bhalej Road, near Gamadi, Dist. Kaira.

54. **S. teliferum** Ralfs.

Pond on the way to Karamsad, behind Engineering College, Vallabh Vidyanagar.

55. **Xanthidium aculeatum** Ehrenb.

Ditches on the sides of Anand-Bhalej Road, near Gamadi, Dist. Kaira.

56. **X. cristatum** Bréb.

Pond on the way to Karamsad, behind Engineering College, Vallabh Vidyanagar.

57. **X. cristatum** var. **delpontei** Roy et Biss.

Pond on the way to Karamsad, behind Engineering College, Vallabh Vidyanagar.

58. **X. cristatum** var. **unicinatum** Bréb.

Pond on the way to Karamsad, behind Engineering College, Vallabh Vidyanagar; ditches near railway line, Vallabh Vidyanagar.

Acknowledgements

The author is grateful to Dr. R. N. Singh, for providing the facilities in his laboratory, Banaras Hindu University, and encouragement throughout the work. Thanks are also due to Shri M. H. Patel for help in collection, and Shri S. Y. Gupte for allowing to refer his thesis for M.Sc.

Sardar Patel University,
Vallabh Vidyanagar,
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December 14, 1967.

R. J. PATEL

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28. *CEROPEGIA HIRSUTA* WIGHT & ARN. (ASCLEPIADACEAE)—A NEW RECORD TO THE UPPER GANGETIC PLAIN

During the botanical exploration of Mirzapur District of Uttar Pradesh, a species of *Ceropegia*, namely, *C. hirsuta* was collected. This species has been reported in many of the Indian Floras and has been recorded from Rajmahal Hills, Maubhum and Ranchi (Haines); Mt.

Abu, Deccan, Konkan and North Kanara (Blatter & McCann; Ganjam, Rampa Hills, Nilgiri and Anamalai Hills (Gamble) and several other areas. It had been collected earlier by the author from Pashan, Poona District. However, this species is not mentioned by Duthie in his FLORA OF THE UPPER GANGETIC PLAIN. Hence, the present record from Mirzapur District, is considered here as a new record for the area.

Ceropegia hirsuta Wight & Arn. in Wight, Contrib. 30, 1834; Hook. f. Fl. Brit. Ind. 4:71, 1883; Cooke, Fl. Pres. Bomb. 2:177, 1904; Haines, Bot. Bih. Ori. 562, 1922; Gamble, Fl. Mad. 2:604, 1956 (BSI reprinted edition); Blatt. & McC. in J. Bombay nat. Hist. Soc. 36:535, 1933; Huber, Mem. Soc. Brot. 12:63, 1957; Sant. & Irani, Univ. Bomb. bot. Mem. 4:30, pl. 3, 1962.

Perennial twiner. Tuber subglobose, 2·5-4·5×1·5-2 cm., with 2-4 slender roots from the sides. Stem slender, when fully stretched up to 2 m. long unbranched, hirsute. Leaves 3-13×22-6·5 cm., lower larger, ovate; upper smaller, ovate to linear-lanceolate, hirsute on both surfaces, glandular; lateral nerves 4-5 pairs; petioles 1-2·5 cm. long, hirsute, grooved above, glandular. Flowers 4-6, in lateral umbellate cymes; peduncles 1·2-2·8 cm. long, red tinged, hirsute; bracts 4-6 mm. long, linear-subulate, hairy; pedicels 0·6-1·3 cm. long, hairy. Calyx-lobes 0·9-1·2 cm. long, linear-subulate. Corolla 4-5 cm. long, slightly curved; glabrous, yellowish green, blotched with purple; hairy and dark purple coloured in the inflated part within; tube 2·5-3 cm. long, at base globular 6 mm. across, narrowed part 5 mm. in breadth; lobes spathulate, 1·7-2 cm. long, connate at tips, forming a globose head, upper half dark purple coloured and with scattered hairs within and without. Outer corona cupular, 2-2·5 mm. long, purple spotted; lobes 5, deltoid, bifid, hairy on the inner surface. Inner corona of 5 linear lobes, 3·5-4·5 mm. long; lobes diverging at the apex, hooked at tips. Follicles not seen.

The plant usually favours low deciduous forests on rocky hill slopes, twining among bushes. It is absent from dense forests. The species has been collected on a small hill slope near Rihand Dam along a forest path. It is not abundant, only two plants have been collected along with tubers, after a careful search in the area.

Haines mentions that the roots of true *.hirsuta* are fibrous, but in his plant it is a flattened globose tuber. Our plants have a subglobose tuber and no fibrous roots are seen. Santapau & Irani mention the occurrence of a gland on either side of the base of the petioles and also glands at the base of the midnerve on the upper side of the lamina; no such glands have been observed in the present

Ludwigia erecta (Linn.) Hara
1. Habit; 2. Capsule; 3. Seed.

collection, even though glands of this type have been noticed in some other species of this genus (*cf. C. lawii* Hook. f. and *C. panchganiensis* Blatt. & McC.).

Flowers: August-September.

Specimens examined: Rhiand Dam, Mirzapur Dist. *Reddi* 1295A-C & 1296 (BAN).

Grateful thanks are due to Dr. A. C. Joshi, Vice-Chancellor, Banaras Hindu University, for guidance and encouragement and to Prof. Dr. R. Misra, Head of the Department of Botany, for providing the necessary facilities.

DEPARTMENT OF BOTANY,
BANARAS HINDU UNIVERSITY, B. VENKATAREDDI
VARANASI-5,
September 7, 1968.

29. *LUDWIGIA ERECTA* (LINN.) HARA (ONAGRACEAE)—A NEW RECORD FOR INDIA

(*With a plate*)

Ludwigia erecta (Linn.) Hara (Figs. 1-3), so far not known from Asia, has been collected from the Indian Botanic Garden, Shibpur, Howrah district (W. Bengal), during the floristic studies on the weeds of the Indian Botanic Garden.

Ludwigia erecta (Linn.) Hara in J. Jap. Bot. 28:292, 1953; Raven in Reinwardtia 6:348, 1963. *Jussiaea erecta* Linn. Sp. Pl. 388, 1753.

For a detailed description refer Raven 348-349.

In vegetative condition it may be sometimes mistaken for *L. perennis* Linn. from which it differs in having 8 stamens and the sharply 4-gonous capsules. It approaches *L. peruviana* (Linn.) Hara, from which it can be readily identified by the following key (*c.* Sreemadhavan in Bull. bot. Surv. India 8:79, 1966).

Plants glabrous to puberulent; capsules 10-19×2-2·5 mm. glabrous or rarely puberulent; seeds 0·3-0·5 mm. long.......... *L. erecta*

Plants puberulent or villous; capsules 12-30×6-10 mm., villous; seeds 0·6-0·8 mm. long.............................. *L. peruviana*

Field notes: Rare, in small numbers, growing in moist places and in a dried pond filled with garden refuse.

Flowers & Fruits: October-November.

Specimens examined: Sharma 597, Nov. 2, 1966; *Sharma* 724, Nov. 3, 1967—deposited in the Central National Herbarium (CAL).

Distribution: Native of the New World, mostly in the tropics, from Central Mexico and Florida to Paraguay and Brazil. Introduced widely throughout tropical Africa, extending to Madagascar, Seychelles and Mascarene Islands.

This New World species is introduced into India, probably only recently, along 'with some nursery stock from somewhere else' as suggested by Raven (Personal communication).

My thanks are due to Mr. C. P. Sreemadhavan for helping in the identification of the species and Dr. Peter H. Raven, Stanford University, Stanford, California, for confirming the identity. I thank Dr. K. Subramanyam for guidance.

BOTANICAL SURVEY OF INDIA,
76 ACHARYA JAGADISH BOSE ROAD,
CALCUTTA-14,
August 21, 1968.

SHARMA S. VUPPULURI

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The breeding of Spotted and Black Leopards

BY

ROY ROBINSON
St. Stephen's Road Nursery, Ealing, London, W. 13, England

(*With two text-figures*)

The black form of the leopard is shown to be inherited as an autosomal recessive to the spotted. The average size of litter from black females is smaller than that of the spotted. Neither the decline in average litter size with parity or age, the frequency distribution of litters per month, the number of litters per year and the sex ratio appears to differ between the black and spotted forms. Significantly more litters are born in the spring and summer months than in the autumn and winter months (Northern hemisphere data). The lower fecundity of the black form may be a factor in the maintenance of the black/spotted polymorphism of certain regions of Asia by opposing the yet unknown advantage possessed by the black morph.

INTRODUCTION

It is well known that the leopard may occur in two colour phases : the normal spotted and a black form. The latter is also known as the black panther. That the two colours belong to the same species is clearly shown by their identical morphology and the fact that they will inter-breed without difficulty. In certain areas of Asia (particularly in areas of extensive forest of Malaysia and Thailand), the spotted and black forms co-exist as a polymorphism (Pocock 1929, Tweedie & Harrison 1965). Genetically, this makes the melanic form of more than usual interest.

HEREDITY

Although it has been appreciated that the black form is the result of a colour mutation, precise information on the mode of inheritance is lacking. It is not necessary to seek far for the reason. Controlled breeding of leopards only occurs in zoos and few zoos could support a sustained breeding programme to determine the heredity. Also, the black form is more economically valuable than the spotted and cross-breeding is not usually undertaken unless a black mate cannot be found. However, despite these obstacles, it was decided that a circular among zoos known to be breeding leopards might produce sufficient data to resolve the problem. Accordingly, 128 zoos were circulated and, of these, 62 kindly made returns of their breeding experiences.

The breeding results obtained from the survey are shown in Table 1. Agreement between numbers of reported offspring and those expected are quite good and reveal that the black form is inherited as a monogenic recessive to spotted. It may be noted that the expected numbers for the first two entries do not fit those of ordinary Mendelian ratios and the reason for this resides in the nature of the data. Heterozygous animals capable of producing black offspring can only be detected by the occurrence of at least one black cub among their offspring. This means that sibships which do not contain black young will be excluded although of heterozygous parentage. Allowance has to be made for this in calculating the expectations. The sibship method of Fisher (1935) has been developed to deal with this situation and has been employed in the analysis. For the equivalent F_2 generation, the estimated frequency of the black gene is 37 per cent, a value which does not differ significantly from the expected 25 per cent ($\chi^2=2{\cdot}0$). The estimate for the equivalent back-cross generation is 51 per cent, a value which scarcely differs from the expected 50 per cent ($\chi^2=0{\cdot}33$).

The decisive results are the breeding of black cubs to spotted parents. This is conclusive evidence for recessive heredity of the black colour. Matings of black parents have given only black offspring. This is in full accord with expectation but the sheer weight of numbers observed is impressive. In addition to the data of the table, 20 matings of spotted$\times$ black are reported in which only spotted progeny are produced. Ordinarily, these matings would not yield useful information but one sibship of 22 spotted young deserves mention. The result is very suggestive that black is recessive since, if it is not, this number of spotted young would be expected to occur by chance about once in 4×10^6 sibships of this size. This would be very long odds for the concept of dominance.

The complete absence of agouti hairs and the production of a uniform black phenotype is indicative that the leopard gene belongs to the general class of non-agouti mutants. It is proposed that the gene be designated non-agouti and be symbolised as *a*. The non-agouti gene does not interfere with the development of the characteristic leopard spots or rosettes because this pigmentary system is independent of agouti. Thus, the spotted pattern can be discerned in the black form as a reflected pattern as the animal moves. It can also be photographically recorded by the use of flash photography.

TABLE 1

THE BREEDING OF SPOTTED AND BLACK LEOPARDS IN ZOOS OF THE WORLD

Parents	Offspring observed		Offspring expected	
	Spotted	Black	Spotted	Black
Spotted × Spotted ..	21	10	23	8
Spotted × Black ..	28	24	26	26
Black × Black ..	—	298	—	298

REPRODUCTION

Some interesting information on reproduction also became available as part of the survey. The average litter size for the leopard is usually taken to be two cubs and this is borne out by the data (Table 2). Rather surprisingly, however, when the litters are partitioned according to the colour of the mother, the black females do not appear to have so many young on the average as the spotted. The difference of means ($0{\cdot}39 \pm 0{\cdot}09$) is statistically significant.

Interpretation of the difference is not easy. The simplest explanation is that the black female is not so fecund as the spotted. This may be the case. However, it is wise to be aware of other factors. For instance, fœtal degeneration is a constant feature of mammalian reproductive physiology and the observed results could arise if the black form is slightly less viable than the spotted. That is, there is a small selective loss of black fœtuses. Against this suggestion is the fact that the number of black cubs is not significantly below expectation as shown by Table 1. However, the number of cubs may not be large enough to detect the small difference involved. Another factor is the unavoidable loss of cubs which occurs between birth and the opportunity to record the colour. The number of such losses are small and there is no indication these are selective.

Once puberty has been attained, leopards will continue to have litters for a large number of years. The data is admittedly incomplete on this

TABLE 2

FREQUENCIES OF LITTER SIZES FOR SPOTTED AND BLACK FEMALE LEOPARDS

Female	No. in litter				No. of litters	Mean ± S.E.
	1	2	3	4		
Spotted	37	89	38	7	171	2·09 ± 0·06
Black	64	78	57	0	159	1·70 ± 0·06

aspect of reproduction but that to hand is shown by Fig. 1. The curves in the figure represent averages of not less than 10 litters per consecutive litter. This had meant some grouping for the higher litter numbers. If this is not done, the graph becomes very erratic due to the small numbers involved (this can be seen for the curve for the spotted females, particularly). Two features are revealed by the figure, the first is the smaller average litter for the black mother in comparison with the spotted and the second is an apparent inherent downward trend. The curve for spotted females behaves erratically for high litter numbers, for the reason mentioned above, but that for black females is more steady and the larger numbers involved tended to stabilise the curve for the total. The decline could be ascribed to an effect of the non-agouti gene but this seems doubtful. The effect is probably due to a fall in fecundity with age, the effect being small at first but increasing progressively.

The distribution of births of litters for zoos in the northern hemisphere throughout the year is indicated by Figure 2. Apparently, there is no difference between the behaviour of the spotted versus black females for the 12-month cycle. However, for both forms there is noticeable seasonal variation. Though some reproductive activity is occurring throughout the year, more litters are born in the spring and summer months than in the autumn and winter months. The frequency distribution of births departs significantly from the simple assumption of uniform occurrence of litters over the twelve months (χ^2=20·1 for 11 degrees of freedom). If a comparison is made for spring and summer months versus autumn and winter months, the significance is greatly increased (χ^2=21·1 for 1 degree of freedom).

The frequency of litters per year per female differs considerably. A few females seem to have litters very irregularly; although the majority appear to have at least one litter per year, even if these are not always reared successfully. However, a fair number seem to have only one, rarely two, as if the reproductive cycle extends slightly beyond twelve

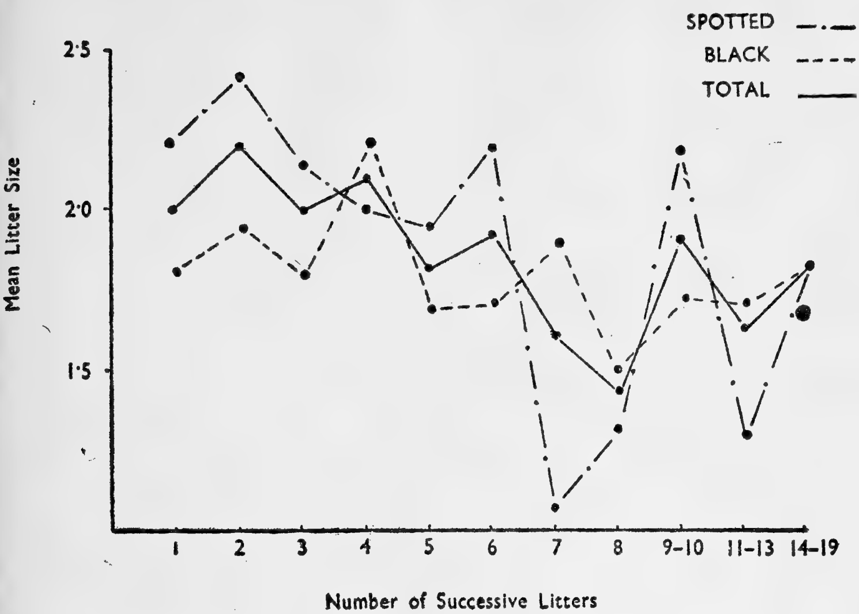

Fig. 1. The trend in mean litter size with successive parities.

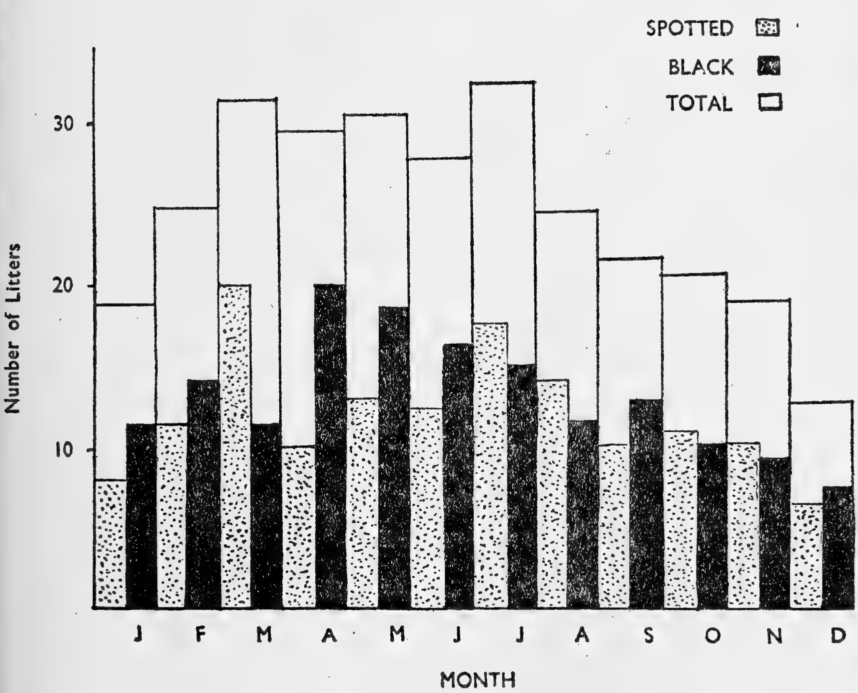

Fig. 2. Distribution of litters throughout the year.

months. Still others, on the other hand, manage two litters per year, with an occasional lapse of one litter per year. This variation, of course, could reflect the environment (housing, diet) in which the animals are kept as much as the innate reproductive rhythm. For instance, it is possible to secure three litters within or just over a year if the young are fostered or hand reared immediately after birth.

The sex ratio does not differ between the spotted and black forms. For 147 spotted animals, the ratio is 113 : 100 of males and females, for 195 black animals, the ratio is 110 : 100. The overall ratio is 111 : 100. This ratio does not differ significantly from equality of the sexes but, nevertheless, would be quite in accord with the general mammalian sex ratio of a small excess of males.

Discussion

Hitherto, there have been differences of opinion whether or not the black form is inherited as a dominant or recessive. Gee (1948) proposed recessive heredity although his data (in keeping with most other) could not establish this unequivocally. However, the problem has now been resolved and it may be conjectured whether the result has any significance for the nature of black variants in other felids. It is not unreasonable to assume that the majority of these black forms are the outcome of single gene mutations. The difficulty is that of deciding upon the mode of inheritance.

Black forms are known to occur in the jaguar, lynx, puma, serval, Temminck's golden cat and tiger (Ulner 1941) and potentially for all other wild felids. The heredity of the black colour will presumably be an enigma until the chance observation of the birth of a black cub from two wild coloured parents or a wild coloured cub from black parents. Yet, can any information be obtained from a minute examination of the black phenotype? Provisionally, yes, for the following proposition may be advanced : when a black animal fails to show any agouti hairs (especially, on the head region, low down on the flanks or on the stomach), the form could be inherited as a recessive. It is true that some recessive black possess yellow hairs (*e.g.* house mouse), but these are restricted to specified areas and emerge under the microscope as all-yellow not banded agouti hairs. Any inference based on phenotype must of necessity be regarded as tentative and be subject to confirmation or otherwise at the earliest possible moment by breeding data. The proposition might not be worth making but for the extreme difficulty of securing breeding data for wild felids.

The spotted or striped pattern so characteristic of most felids is a pigmentary system independent of agouti and displays variation. Frequently, this is in the direction of greater melanism, where spots or rosettes fuse to form stripes or stripes to form blotches. Ulner (1941) has described a leopard in which the spots coalesced to produce stripes on the back. In this sort of melanism, agouti coloration is persistent even if reduced in amount, hence there is no question of recessive non-agouti inheritance. In the domestic cat, the blotched *catus* pattern is inherited as a recessive to the striped wild type *silvestris* (Robinson 1959). However, it would be unwise to deduce too much from this. Unlike non-agouti, which occurs in many species and invariably behaves as a recessive, the *catus* type melanism of the cat is the only analysed case of its kind.

The apparent lower fecundity of the black form invites comparison with the persistence of the spotted/black polymorphism of the leopard in parts of south-east Asia. If the disadvantage also operates in the wild, it is tempting to suppose that it may be a factor in the maintenance of the polymorphism. The black form has an evident advantage over the spotted, otherwise it would not be so persistent. Polymorphisms exist because of the inter-play of balancing opposing selective forces. The leopard case could be of the simplest kind, of course, such as the influx of dominant spotted genes from outlying areas where the black phenotype has no advantage. On the other hand, the polymorphism could be more complex and the infecundity could be one of the negative factors involved. If the situation is complex, the failure of the black form to completely displace the spotted could hinge on the infecundity. Unfortunately, little is known of the totality of factors which contribute towards the polymorphism. Among the positive factors, greater concealment is a facile possibility but experimental verification of this in the field would be desirable.

Acknowledgement

I wish to thank the Directors and Scientific Staff of the many zoos who have contributed breeding data for this investigation.

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A contribution to the Flora of Salsette Island, Bombay (Malad-Madh Area)

BY

H. SANTAPAU AND G. L. SHAH [1]

St. Xavier's College, Bombay

INTRODUCTION

Though many distinguished botanists have explored various parts of Bombay, none seems to have paid particular attention to Bombay and Salsette islands. The area selected for the present study covers much of the western part of Salsette Island, just north of Bombay city and island. The area of Malad-Madh is divided into two rather unequal parts by the Western Railway, which runs NS. The portion on the eastern side of the railway line consists of cultivated fields just above sea-level, with an occasional hill rising up to 100 m. The western portion of the area covers Madh Island, and is separated by Malad Creek; a large part of this section is covered by mud flats which, at high tide, become fully submerged.

The climate of the area is of the monsoon type, with a rainless and comparatively cool season from November to February, a hot dry season from March to May, and very wet season during June to September. The average rainfall for the area is 220 cm. going up to a maximum of 350 cm. and a minimum of 156 cm.

There is practically no spot in the area, which has not been subjected to very drastic deforestation; constant cutting of woody species, overgrazing on the herbaceous plants, and summer fires have all combined to turn the area into a very poor type of Southern Moist Deciduous Forest, or of Deciduous Monsoon Forest, to use the terminology of Champion. With the advent of the monsoon, however, the ground becomes covered with dense herbaceous vegetation; the cultivated fields soon turn a brilliant green with *Oryza sativa* Linn. covering almost every inch of their surface.

Along the sea shores and sea creek the typical mangrove vegetation can be seen throughout the year; but even here there is constant cutting of woody species either for firewood or for the tanning of fishing nets.

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[1] Present address: Department of Botany, Sardar Patel University, Vallabh Vidyanagar, Gujarat.

It is rare to see any mangrove tree over 3 metres in height in the area.

In the following enumeration, the order is the same as that of Cooke's FLORA OF THE PRESIDENCY OF BOMBAY; the nomenclature is generally that of Cooke's FLORA, occasionally the name has been changed to what in our opinion is the correct scientific name of the plant. An asterisk before the name indicates that the plant is not listed by Cooke. In all 640 taxa of plants are enumerated, most of them collected by the junior author in the field during the years 1954-1960; all the specimens on which this paper is based are housed in Blatter Herbarium, St. Xavier's College, Bombay.

ENUMERATION OF PLANTS

RANUNCULACEAE

Clematis hedysarifolia DC.

ANNONACEAE

Annona squamosa Linn.

MENISPERMACEAE

Cissampelos pareira Linn.
Cocculus hirsutus (Linn.) Diels
Cyclea burmanni (DC.) Hook.f.
Tinospora cordifolia (Willd.) Miers ex Hook. f. & Thoms.

NYMPHAEACEAE

Nymphaea nouchali Burm. f.
N. stellata Willd.

PAPAVERACEAE

Argemone mexicana Linn.

CRUCIFERAE

Brassica nigra (Linn.) Koch
Raphanus sativus Linn.

CAPPARIDACEAE

Cadaba fruticosa (Linn.) Druce
Capparis sepiaria Linn.
C. zeylanica Linn.
Cleome burmanni Wt. & Arn.
Cleome chelidonii Linn. f.
C. gynandra Linn.
C. viscosa Linn.

VIOLACEAE

Hybanthus enneaspermus (Linn.) F. Muell.

FLACOURTIACEAE

Flacourtia indica (Burm.f.) Merrill

POLYGALACEAE

Polygala chinensis Linn.

CARYOPHYLLACEAE

Polycarpon prostratum (Forsk.) Aschers. & Schweinf.

PORTULACACEAE

Portulaca oleracea Linn.

ELATINACEAE

Bergia ammannioides Heyne ex Roth
B. capensis Linn.

GUTTIFERAE

Calophyllum inophyllum Linn.
Mammea suriga (Buch.-Ham. ex Roxb.) Kosterm.

MALVACEAE

Abelmoschus esculentus (Linn.) Moench.
A. manihot (Linn.) Medic.
Abutilon indicum (Linn.) Sw.
Azanza lampas (Cav.) Alef.
Hibiscus cannabinus Linn.
H. furcatus Willd.
H. lobatus (Murr.) O. Kuntze
H. vitifolius Linn.
Malachra capitata Linn.
Sida acuta Burm. f.
S. cordifolia Linn.
S. rhombifolia L. var. *retusa* (Linn.) Masters
S. spinosa Linn.
S. veronicifolia Lamk.
Thespesia populnea (Linn.) Soland. ex Corr.
Urena lobata Linn.
Bombax ceiba Linn.

STERCULIACEAE

Helicteres isora Linn.
Melochia corchorifolia Linn.
Sterculia foetida Linn.
S. villosa Roxb. ex DC.
S. urens Roxb.
Waltheria indica Linn.

TILIACEAE

Corchorus aestuans Linn.
C. fascicularis Lamk.
C. olitorius Linn.
Grewia abutilifolia Vent. ex Juss.
G. columnaris Sm.
G. disperma Rottl. ex Spreng.
G. subinaequalis DC.
G. tiliaefolia Vahl.
Microcos paniculata Linn.
**Triumfetta pentandra* A. Rich.
T. rhomboidea Jacq.
T. rotundifolia Lamk.

BALSAMINACEAE

Impatiens balsamina Linn. var. *balsamina*

OXALIDACEAE

Biophytum sensitivum (Linn.) DC.
Oxalis corniculata Linn.

RUTACEAE

Aegle marmelos Corr.
Feronia limonia (Linn.) Sw.

BURSERACEAE

Garuga pinnata Roxb.

MELIACEAE

Azadirachta indica (Linn.) A. Juss.

OPILIACEAE

Cansjera rheedii Gmel.

CELASTRACEAE

Celastrus paniculata Willd.

RHAMNACEAE

Zizyphus glabrata Heyne ex Roth
Z. mauritiana Lamk.
Z. oenoplia Mill.
Z. rugosa Lamk.

VITACEAE

Ampelocissus latifolia (Roxb.) Planch.
Cayratia carnosa Gangnep.
Cissus repanda Vahl
Leea cinerea Laws.
L. edgeworthii Santapau
L. macrophylla Roxb. ex Hornem.

SAPINDACEAE

Sapindus laurifolius Vahl
Cardiospermum halicacabum Linn.

ANACARDIACEAE

Anacardium occidentale Linn.
Buchanania lanzan Spreng.
Lannea coromandelica (Houtt.) Merrill
Mangifera indica Linn.
Semecarpus anacardium Linn.f.

MORINGACEAE

Moringa oleifera Lamk.

PAPILIONACEAE

Abrus precatorius Linn.
Aeschynomene indica Linn.
Alysicarpus bupleurifolius (Linn.) DC.
A. longifolius (Rottl.) Wt. & Arn.
A. procumbens (Roxb.) Schindl.
A. glumaceus (Vahl) DC.
A. vaginalis (Linn.) DC.
Atylosia scarabaeoides (Linn.) Benth.
Butea monosperma (Lamk.) Taub.
B. parviflora Roxb.
Cajanus cajan Millsp.
Canavalia gladiata (Jacq.) DC.
Cicer arietinum Linn.
Clitoria biflora Dalz.
C. ternatea Linn.
Crotalaria albida Heyne ex Roth
C. filipes Benth.
C. juncea Linn.
C. leptostachya Benth.
C. medicaginea Lamk.
C. retusa Linn.
C. triquetra Dalz.
Cylista scariosa Roxb.
Dalbergia volubilis Roxb.
Derris scandens (Roxb.) Benth.
Desmodium dichotomum (Willd.) DC.
D. gangeticum (Linn.) DC.
D. laxiflorum DC.
Desmodium triangulare var. *congestum* Santapau
D. triflorum (Linn.) DC.
D. triquetrum (Linn.) DC.
Dolichos lablab Linn.
Dunbaria glandulosa (Dalz. & Gibs.) Prain
Erythrina indica Lamk.
Geissaspis cristata Wt. & Arn.
Gliricidia sepium (Jacq.) Walp.
Indigofera cordifolia Heyne ex Roth
I. glandulosa Roxb. ex Willd.
I. astragalina DC.
I. linifolia Retz.
I. linnaei Ali
I. trifoliata Linn.
I. tinctoria Linn.
Lathyrus sativus Linn.
Moghania tuberosa (Dalz.) O. Kuntze
Mucuna prurita Hk.f.
Phaseolus radiatus Linn.
P. trilobus Ait.
Pisum sativum Linn.
Pongamia pinnata (Linn.) Pierre
Pterocarpus marsupium Roxb. var. *acuminatus* Prain
Pueraria tuberosa (Roxb. ex Willd.) DC.
**Rhynchosia rothii* Benth. ex Aitch.
Sesbania bispinosa (Jacq.) W. F. Wight
S. grandiflora (Linn.) Pers.
S. sesban (Linn.) Merrill var. *picta* (Prain) Santapau
Smithia sensitiva Ait.
S. conferta Sm.
S. salsuginea Hance
Tephrosia senticosa Pers.
T. purpurea (Linn.) Pers.
T. strigosa (Dalz.) Santapau & Maheshwari

Teramnus labialis (Linn.f.) Spreng.
Trigonella foenum-graecum Linn.
**Uraria rufescens* (DC.) Schindl.
Vigna capensis Walp.
V. unguiculata (Linn.) Walp.
Zornia gibbosa Span.

CAESALPINIACEAE

Bauhinia purpurea Linn.
B. racemosa Lamk.
Caesalpinia crista Linn.
Cassia absus Linn.
C. occidentalis Linn.
C. pumila Lamk.
C. siamea Lamk.
C. tora Linn.
Delonix regia (Boj.) Ref.
Tamarindus indica Linn.

MIMOSACEAE

Acacia nilotica (Linn.) Del. ssp. *indica* Brenan
A. pennata (Linn.) Willd.
Leucaena leucophloea (Lamk.) de Wit
Mimosa pudica Linn.
Pithecolobium dulce (Roxb.) Benth.

VAHLIACEAE

Vahlia digyna (Retz.) O. Kuntze

DROSERACEAE

Drosera indica Linn.

RHIZOPHORACEAE

Ceriops tagal (Perr.) C. B. Robins
Rhizophora mucronata Lamk.

COMBRETACEAE

Anogeissus latifolia (Roxb.) Wall. ex Bedd.
Calycopteris floribunda (Roxb.) Lamk.
Combretum ovalifolium Roxb.
Lumnitzera racemosa Willd.

MYRTACEAE

Syzygium cumini (Linn.) Skeels
Careya arborea Roxb.
Memecylon umbellatum Burm. f.
Osbeckia truncata Don

LYTHRACEAE

Ammannia baccifera Linn.
A. multiflora Roxb.
Lawsonia inermis Linn.
Rotala densiflora (Roth) Koehne
R. indica (Willd.) Koehne
Woodfordia fruticosa (Linn.) Kurz

ONAGRACEAE

Ludwigia octovalvis ssp. *sessiliflora* Raven
L. perennis Linn.

TRAPACEAE

Trapa natans Linn. var. *bispinosa* Makino

SAMYDACEAE

Casearia elliptica Willd.
C. graveolens Dalz.

TURNERACEAE

**Turnera ulmifolia* Linn.

PASSIFLORACEAE

Passiflora foetida Linn.

CARICACEAE

Carica papaya Linn.

CUCURBITACEAE

Citrullus lanatus (Thunb.) Mansf.
Coccinia cordifolia (Linn.) Cogn.
Cucumis callosus (Rottl.) Cogn.
Cucurbita maxima Duch.

Diplocyclos palmatus (Linn.) Jeffrey
Lagenaria leucantha (Duch.) Rusby
Luffa acutangula (Linn.) Roxb.
L. cylindrica (Linn.) Roem.
Mukia maderaspatana (Linn.) M. Roem.
Solena heterophylla Lour.
Momordica charantia Linn.
M. dioica Roxb. ex Willd.
Trichosanthes anguina Linn.
T. cucumerina Linn.

CACTACEAE

Opuntia elatior Mill.

FICOIDACEAE

Sesuvium portulacastrum (Linn.) Linn.
Trianthema portulacastrum Linn.

MOLLUGINACEAE

Glinus lotoides Linn.
G. oppositifolius (Linn.) DC.
Mollugo pentaphylla Linn.

UMBELLIFERAE

Coriandrum sativum Linn.

RUBIACEAE

Adina cordifolia (Roxb.) Benth. & Hk. f. ex Brandis
Borreria articularis F.N. Will.
B. stricta (Linn. f.) Schum.
Dentella repens Forst.
Ixora brachiata Roxb.
I. coccinea Linn.
Meyna laxiflora Robyns
Mitragyna parvifolia (Roxb.) Korth.
Morinda tomentosa Heyne ex Roth
Neanotis foetida (Hook.f.) Lewis
Oldenlandia corymbosa Linn.
Xeromphis spinosa (Thunb.) Keay

COMPOSITAE

**Acanthospermum hispidium* DC.
Ageratum conyzoides Linn.
Bidens biternata (Lour.) Merrill & Sherff.
Blainvillea acmella (Linn.) Philip.
Blumea eriantha DC.
B. membranacea DC.
B. mollis (Don) Merrill
B. obliqua (Linn.) Druce
B. oxyodonta DC.
Caesulia axillaris Roxb.
Centratherum phyllolaenum (DC.) Benth.
Eclipta prostrata (Linn.) Linn.
Elephantopus scaber Linn.
Emilia sonchifolia (Linn.) DC.
Epaltes divaricata Cass.
Gnaphalium indicum Linn.
Grangea maderaspatana (Linn.) Poir.
Guizotia abyssinica Cass.
Laggera aurita (Linn. f.) Sch.-Bip.
Launaea fallax (Jaub. & Spach.) O. Kuntze
L. sarmentosa (Willd.) Alst.
Sphaeranthus africanus Linn.
S. indicus Linn.
**Synedrella nodiflora* (Linn. ex Willd.) Gaertn.
Tricholepis glaberrima DC.
Tridax procumbens Linn.
Vernonia anthelmintica (Linn.) Willd.
V. cinerea (Linn.) Less.
Vicoa indica (Willd.) DC.
Xanthium strumarium Linn.

CAMPANULACEAE

Sphenoclea zeylanica Gaertn.

LOBELIACEAE

Lobelia alsinoides Lamk.

PLUMBAGINACEAE

Plumbago zeylanica Linn.

MYRSINACEAE

Aegiceras corniculatum (Linn.) Blanco
Embelia tsjariam-cottam (Roem.& Schult.) DC.

SAPOTACEAE

Madhuca indica Gmel.
Manilkara hexandra (Roxb.) Dub.

EBENACEAE

Diospyros melanoxylon Roxb.

OLEACEAE

Jasminum malabaricum Wt.
J. multiflorum (Burm.) Andr.

SALVADORACEAE

Salvadora persica Linn.

APOCYNACEAE

Carissa congesta Wt.
Catharanthus roseus (Linn.) Don
Holarrhena antidysenterica Wall. ex A. DC.
Nerium indicum Mill.
Thevetia peruviana (Pers.) Merrill

ASCLEPIADACEAE

Calotropis gigantea (Linn.) R. Br.
Ceropegia bulbosa Roxb.
Dregea volubilis (Linn.f.) Benth. ex Hook. f.
Holostemma annulare (Roxb.) Schum.
Leptadenia reticulata (Retz.) Wt. & Arn.
Oxystelma secamone (Linn.) Karst.
Pentatropis spiralis (Forsk.) Decne.
Pergularia daemia (Forsk.) Chiov.

PERIPLOCACEAE

Cryptolepis buchanani Roem. & Schult.
Hemidesmus indicus (Linn.) Schult.

LOGANIACEAE

Cynoctonum mitreola (Linn.) Britt.

GENTIANACEAE

Canscora diffusa (Vahl) R. Br.
Centaurium roxburghii (Don) Druce
Enicostemma verticillatum (Willd.) Baill.
Exacum pedunculatum Linn.
E. pumilum Griesb.
Hoppea dichotoma Willd.
Nymphoides cristatum (Roxb.) O. Kuntze
N. indicum (Linn.) O. Kuntze

HYDROPHYLLACEAE

Hydrolea zeylanica (Linn.) Vahl

BORAGINACEAE

Coldenia procumbens Linn.
Cordia obliqua Willd.
Heliotropium indicum Linn.
H. marifolium Retz.
H. marifolium Retz. var. *laxiflora* Cooke
H. ovalifolium Forsk.
Trichodesma amplexicaule Roth

CONVOLVULACEAE

Argyreia sericea Dalz.
Cressa cretica Linn.
Cuscuta reflexa Roxb.
Evolvulus alsinoides (Linn.) Linn.
E. nummularius Linn.
Ipomoea aquatica Forsk.
I. cairica (Linn.) Sw.
I. eriocarpa R. Br.

Ipomoea fistulosa Mart. ex Choisy
I. hederifolia Linn.
I. mauritiana Jacq.
I. muricata (Linn.) Jacq.
I. nil (Linn.) Roth
I. obscura (Linn.) Ker-Gawl.
I. pes-caprae (Linn.) R. Br.
I. pes-tigridis Linn.
I. quamoclit Linn.
I. sepiaria Koen. ex Roxb.
I. triloba Linn.
Jacquemontia paniculata (Burm.f.) Hall. f.
Merremia aegyptia (Linn.) Urb.
M. gangetica (Linn.) Cufodont
**M. quinquefolia* (Linn.) Hall.f.
M. tridentata (Linn.) Hall.f.
Rivea hypocrateriformis Choisy

SOLANACEAE

Datura metel Linn.
**Physalis longifolia* Nutt.
P. minima Linn.
Solanum indicum Linn.
S. nigrum Linn.
S. surattense Burm. f.

SCROPHULARIACEAE

Centranthera indica (Linn.) Gamble
Dopatrium junceum (Roxb.) Buch.-Ham.
Limnophila indica (Linn.) Druce
L. sessiliflora (Vahl) Blume
Lindernia antipoda (Linn.) Alst.
L. ciliata (Colsm.) Pennell
L. crustacea (Linn.) Muell.
L. oppositifolia (Retz.) Mukerjee
L. parviflora (Roxb.) Haines
L. viscosa (Hornem.) Boldingh
Peplidium maritimum (Linn.f.) Wettst.
Rhamphicarpa longiflora (Arn.) Benth.
Scoparia dulcis Linn.
Sopubia delphinifolia (Roxb.) Don
Stemodia viscosa Roxb.
Striga lutea Lour. var. *lutea*
S. angustifolia (Don) Saldhana
Torenia asiatica Linn.

LENTIBULARIACEAE

Utricularia flexuosa Vahl
U. reticulata Sm.
U. inflexa Forsk. var. *stellaris* (Linn.f.) Taylor

BIGNONIACEAE

Heterophragma quadriloculare (Roxb.) K. Schum.
Oroxylum indicum (Linn.) Vent.
Stereospermum personatum (Hassk.) Chatterjee

PEDALIACEAE

Pedalium murex Linn.
Sesamum indicum Linn.

MARTYNIACEAE

Martynia annua Linn.

ACANTHACEAE

Acanthus ilicifolius Linn.
Andrographis paniculata (Burm.f.) Wall. ex Nees
Barleria prattensis Santapau
B. prionitis Linn.
Blepharis asperrima Nees
B. maderaspatensis (Linn.) Roth
B. molluginifolia Pers.
Dicliptera verticillata (Forsk.) Christ.
Dipteracanthus prostratus (Poir.) Nees
Ecbolium viride (Forsk.) Alst. var. *dentata* Raizada
Eranthemum roseum (Vahl) R. Br.

Gantelbua urens (Heyne ex Roth) Bremek.
Gendarussa vulgaris Nees
Haplanthus nilgherrensis Wt.
Hemiadelphis polyspermus Nees
Hemigraphis latebrosa Nees var. *heyneana* Bremek.
Hygrophila auriculata (Schumach.) Heine
H. serpyllum (Nees) T. Anders.
Justicia procumbens Linn.
J. simplex D. Don
Lepidagathis cuspidata Nees
L. trinervis Nees
Neuracanthus sphaerostachyus (Nees) Dalz.
Peristrophe bicalyculata (Retz.) Nees
Rhinacanthus nasuta (Linn.) Kurz
**Ruellia tuberosa* Linn.
Rungia pectinata (Linn.) Nees
R. repens (Linn.) Nees

VERBENACEAE

Avicennia alba Blume
A. officinalis Linn.
Clerodendrum inerme (Linn.) Gaertn.
C. multiflorum (Burm.f.) O. Kuntze
Gmelina arborea Roxb.
Lantana camara Linn. var. *aculeata* (Linn.) Moldenke
Phyla nodiflora (Linn.) Greene
Premna corymbosa (Burm.f.) Rottl.
Tectona grandis Linn.f.

LABIATAE

Anisomeles heyneana Benth.
Hyptis suaveolens (Linn.) Poit.
Leucas aspera (Willd.) Spreng.
L. mollissima Benth.
Ocimum americanum Linn.
Ocimum basilicum Linn.
O. gratissimum Linn.
Orthosiphon glabratus Benth.
Pogostemon parviflorus Benth.

NYCTAGINACEAE

Boerhavia diffusa Linn.

AMARANTACEAE

Achyranthes aspera Linn.
Aerva lanata (Linn.) Juss.
**Alternanthera ficoidea* (Linn.) R. Br.
**A. pungens* H.B.K.
A. sessilis (Linn.) R. Br.
Amaranthus hybridus Linn. ssp. *cruentus* (Linn.) Thell. var. *paniculatus* (Linn.) Thell.
A. spinosus Linn.
A. tricolor Linn.
A. viridis Linn.
Celosia argentea Linn.
Digera muricata (Linn.) Mart.
**Gomphrena celosioides* Mart.
Nothosaerva brachiata (Linn.) Wt.

BASELLACEAE

Basella rubra Linn.

CHENOPODIACEAE

Arthrocnemum indicum (Willd.) Moq.
Suaeda fruticosa (Linn.) Forsk.

POLYGONACEAE

Antigonon leptopus Hk. & Arn.
Polygonum glabrum Willd.
P. plebeium R. Br.

ARISTOLOCHIACEAE

Aristolochia indica Linn.

PIPERACEAE

Peperomia pellucida (Linn.) H.B.K.

LAURACEAE

Cassytha filiformis Linn.
Litsea deccanensis Gamble

LORANTHACEAE

Dendrophthoe falcata (Linn.f.) Ettings.
Viscum articulatum Burm. f.

EUPHORBIACEAE

Acalypha indica Linn.
Breynia patens Rolfe.
Bridelia hamiltoniana Wall. ex Muell.
B. retusa (Linn.) Spreng.
**B. squamosa* (Lamk.) Gehrm.
Chrozophora prostrata Dalz.
Euphorbia bombaiensis Santapau
E. hirta Linn.
E. neriifolia Linn.
E. parviflora Linn.
Excoecaria agallocha Linn.
Jatropha gossypifolia Linn.
Kirganelia reticulata (Poir.) Baill.
Mallotus philippensis (Lamk.) Muell.-Arg.
Phyllanthus fraternus Webster
P. maderaspatensis Linn.
P. urinaria Linn.
Ricinus communis Linn.
Securinega leucopyrus (Willd.) Muell.-Arg.
S. virosa (Roxb. ex Willd.) Pax & Hoffm.
Trewia polycarpa Benth. & Hook.f. ex Hook.f.

ULMACEAE

Holoptelea integrifolia (Roxb.) Planch.
Trema orientalis (Linn.) Lour.

URTICACEAE

Fleurya interrupta (Linn.) Gaud.
Pilea microphylla (Linn.) Liebm.
Pouzolzia zeylanica (Linn.) Benn.

MORACEAE

Ficus asperrima Roxb.
F. bengalensis Linn.
F. drupacea Thunb. var. *pubescens* (Roth) Corner
F. hispida Linn.f.
F. racemosa Linn.
F. religiosa Linn.
F. tinctoria Forst. f. ssp. *parasitica* King var. *parasitica*
F. virens Ait.
Streblus asper Lour.

CASUARINACEAE

Casuarina equisetifolia Forst.

CERATOPHYLLACEAE

Ceratophyllum demersum Linn.

HYDROCHARITACEAE

Blyxa echinosperma (Clke.) Hook.f.
Hydrilla verticillata (Linn.f.) Royle
Ottelia alismoides (Linn.) Pers.

ORCHIDACEAE

Acampe praemorsa (Roxb.) Blatter & McCann
Dendrobium ovatum (Willd.) Kranzl.
Habenaria marginata Coleb.
Rhynchostylis retusa (Linn.) Blume

ZINGIBERACEAE

Costus speciosus (Koenig ex Roxb.) Smith
**Curcuma inodora* Blatter

HYPOXIDACEAE

Curculigo orchioides Gaertn.

Taccaceae

Tacca leontopetaloides (Linn.) O. Kuntze

Dioscoreaceae

* *Dioscorea belophylla* Voigt
D. bulbifera Linn.
D. pentaphylla Linn.
* *D. wallichii* Hk.f.

Liliaceae

Asparagus racemosus Willd. var. *javanica* Baker
Chlorophytum tuberosum (Roxb.) Baker
Gloriosa superba Linn.
Iphigenia indica (Linn.) Gray
Scilla hyacinthina (Roth) Macbr.
Urginea indica (Roxb.) Kunth

Smilacaceae

Smilax zeylanica Linn.

Commelinaceae

Commelina benghalensis Linn.
C. diffusa Burm. f.
C. hasskarlii Clke.
C. paleata Hassk.
Cyanotis axillaris (Linn.) Schult.
C. cristata (Linn.) Schult.
C. fasciculata (Heyne ex Roth) Schult.
Murdannia nudiflorum (Linn.) Brenan
M. semiteres (Dalz.) Santapau
M. spiratum (Linn.) Brüeck.
M. versicolor (Dalz.) Brüeck.

Palmae

Borassus flabellifer Linn.
Caryota urens Linn.
Cocos nucifera Linn.
Phoenix sylvestris (Linn.) Roxb.

Pandanaceae

Pandanus tectorius Soland. ex Parkinson

Typhaceae

Typha angustata Bory & Chaub.

Araceae

Amorphophallus campanulatus (Roxb.) Blume ex Decais.
A. commutatus (Schott) Engler
Colocasia esculenta (Linn.) Schott.

Alismaceae

Limnophyton obtusifolium (Linn.) Miq.

Aponogetonaceae

Aponogeton natans (Linn.) Krause & Engler

Eriocaulaceae

* *Eriocaulon dianae* Fyson
* *E. dianae* Fyson var. *longibracteatum* Fyson
* *E. eleanorae* Fyson
* *E. vanheurkii* Muell.-Arg.

Cyperaceae

Cyperus albomarginatus Mart. & Schrad.
C. arenarius Retz.
C. bulbosus Vahl
C. compactus Retz.
C. difformis Linn.
C. exaltatus Retz.
C. iria Linn.
C. kyllingia Endl.
C. leucocephalus Retz.
C. malabaricus (Clke.) Cooke
* *C. metzii* (Hochst.) Mattf. & Kükenth.
C. michelianus (Linn.) Link ssp. *pygmaeus* (Rottb.) Aschers. & Graebn.

Cyperus nutans Vahl var. *eleusinoides* (Kunth) Haines
C. pangorei Rottb.
C. pumilus Linn.
C. rotundus Linn.
C. squarrosus Linn.
C. tenuispica Steud.
C. triceps (Rottb.) Endl.
Eleocharis atropurpurea Kunth
E. acutangula (Roxb.) Schult.
Fimbristylis aestivalis Vahl
F. bisumbellata (Forsk.) Bub.
F. dichotoma (Linn.) Vahl
F. falcata (Vahl) Kunth
F. ferruginea (Linn.) Vahl
F. littoralis Gaud.
F. miliacea (Linn.) Vahl
F. polythricioides Vahl
F. spathacea Roth
F. schoenoides Vahl
F. tenera Roem. & Schult.
F. tetragona R. Br.
Fuirena ciliaris (Linn.) Roxb.
Rhynchospora wightiana (Nees) Steud.
Scirpus articulatus Linn.
S. grossus Linn.f.
S. lateriflorus Gmel.
S. maritimus Linn.
Scleria tessellata Willd. var. *biflora* Blatt. & McC.

GRAMINEAE

Aeluropus lagopodioides (Linn.) Trin. ex Thw.
Apluda mutica Linn.
Arthraxon lancifolius (Trin.) Hochst.
Arundinella metzii Hochst.
Bothriochloa pertusa (Linn.) A. Camus
Brachiaria ramosa (Linn.) Stapf
Capillipedium filiculme (Hook.f.) Stapf
C. huegelii (Hack.) Camus
Chionachne koenigii (Spr.) Thw.
Chloris barbata (Linn.) Sw.
* *C. montana* Roxb.
* *C. quinquesetica* Bhide
* *C. virgata* Sw.
Coix lachryma-jobi Linn.
Cynodon dactylon (Linn.) Pers.
Dactyloctenium aegyptiacum (Linn.) P. Beauv.
D. scindicum Boiss.
Desmostachya bipinnata (Linn.) Stapf
* *Digitaria adscendens* (H.B.K.) Henrard
* *D. adscendens* (H.B.K.) ssp. *adscendens* var. *criniformis* Henrard
D. granularis (Trin.) Henrard
D. longiflora (Retz.) Pers.
D. stricta Roth var. *stricta*
* *D. timorensis* (Kunth) Balsana ssp. *blepharophora* Henrard
Dimeria stapfiana Hubb. ex Pilger
Diplachne fusca (Linn.) Beauv.
Echinochloa colonum (Linn.) Link
E. crus-galli (Linn.) Beauv.
Eleusine indica (Linn.) Gaertn.
Elytrophorus spicatus (Willd.) A. Camus
Eragrostis ciliaris (Linn.) R. Br.
E. nutans (Retz.) Nees
E. pilosa (Linn.) Beauv.
* *E. tef* (Zucc.) Trott.
E. tenella (Linn.) Beauv.
E. tremula (Lamk.) Hochst.
E. unioloides (Retz.) Nees ex Steud.
Eriochloa procera Hubb.
Eulalia fimbriata (Hack.) O. Kuntze
Heteropogon contortus (Linn.) Beauv.
* *Isachne dispar* Trin.

I. globosa (Thunb.) O. Kuntze
* *Ischaemum goebelii* Hack.
I. indicum (Houtt.) Merrill
* *I. santapau* Bor
Iseilema laxum Hack.
Melanocenchris jacquemontii Jaub. & Spach.
Ophiurus exaltatus (Linn.) O. Kuntze
Oplismenus burmannii (Retz.) Beauv.
* *Oryza rufipogon* Griff.
O. sativa Linn.
* *Panicum psilopodium* Trin.
* *P. psilopodium* Trin. var. *coloratum* Hk.f.
Paspalidium flavidum (Retz.) A. Camus
* *Paspalum orbiculare* Forst.
P. scrobiculatum Linn.
Pennisetum typhoides (Burm.f.) Stapf & Hubb.
Pseudanthistiria heteroclita (Roxb.) Hook.f.
Pseudoraphis spinescens (R.Br.) Vickary
Saccharum spontaneum Linn.
Sacciolepis interrupta (Willd.) Stapf
Setaria verticillata Beauv.
S. glauca (Linn.) Beauv.
S. intermedia Roem. & Schult.
* *S. pallide-fusca* (Schum.) Stapf
S. tomentosa (Roxb.) Kunth
* *Sporobolus capillaris* Miq.
S. marginatus A. Rich.
Spinifex littoreus (Burm.f.) Merrill
Themeda quadrivalvis Linn.
T. triandra Forsk.

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Observations on the Life History and Bionomics of the Carp Minnow, *Oxygaster bacaila* (Hamilton)

BY

S. PARAMESWARAN[1], C. SELVARAJ[2] AND S. RADHAKRISHNAN[2]
Pond Culture Unit of Central Inland Fisheries Research Institute, Joysagar, Assam

(*With three text-figures*)

Observations on the maturation, breeding season, sexual dimorphism, fecundity, induced breeding, life history, food and feeding habits of *Oxygaster bacaila* have been made and the data compared with the published information on allied species.

INTRODUCTION

Oxygaster bacaila is one of the medium sized species of the genus with its distribution 'throughout India except Malabar, Mysore, Madras and parts of Deccan' (Day 1878). It is common in ponds in Assam along with other 'weed' fishes like *O. phulo*, *Amblypharyngodon mola*, *Osteobrama cotio*, *Puntius* spp., *Ambassis ranga* and *Ambassis nama*. *O. bacaila* and allied species occur abundantly in all inland waters and constitute a minor fishery in some areas (Alikunhi & Chaudhuri 1954). Preliminary observations made at Cuttack on the culture of *O. bacaila* as a forage fish indicated that the total production, calculated per hectare, within a period of four and a half months was 187.7 kg. (Anon. 1955).

Information on the bionomics and life history of the genus *Oxygaster* is still scanty. The main contributions are the brief accounts on the food and feeding habits and development of *O. argentea* (Chacko *et al.* 1946), *O. untrahi* (Chacko 1951), the biology of *O. gora* (Sehgal & Singh 1962) and a paper on the bionomics and life history of *O. phulo* (Alikunhi & Chaudhuri 1954). In the present work, observations on the life history and some aspects of the bionomics of *O. bacaila* are reported.

MATERIAL AND METHODS

Monthly collections of the fish, to study the maturation, food and feeding habits, were made from the Government Fish Farm, Joysagar, and adjoining waters. The maturity stages were fixed following the 'Interna-

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Present address :— [1] Central Inland Fisheries Research Substation, Hazaribagh, Bihar.
[2] Experimental Fish Farm of Central Inland Fisheries Research Institute, Panna, Madhya Pradesh.

tional scale' (Wood 1930). For fecundity studies, mature females preserved in formalin were measured and weighed, the weights of the ovaries recorded, the number of ova from two samples of one gramme each was counted and the total number of ova in each ovary was computed.

Mature fish were induced to breed in the laboratory by administration of carp pituitary hormones and the embryonic and larval developmental stages were studied. Ten specimens were measured to find out the average measurements of the larval and post-larval stages described.

To study the food and feeding habits of the fish, the fore-gut with stomach was dissected out and the contents transferred to a slide and examined under a microscope. The percentage composition of the different items was determined by 'eye estimation'.

Breeding Season

Maturation

The mature males ranged in length from 79 to 117 mm. and females, from 98 to 149 mm. The males appear to be slightly smaller in size than the females.

The gonads were stages II-III of maturity in January. By the end of February and early March, some of the males had attained the V stage and were oozing milt on gentle pressure, but the females were mostly in III-IV stages. During late March the majority of females were in IV stage, while stray ones were in V stage. Bulk of the females, however, were found to be fully mature by the end of April and early May. The spawning season appears to extend from last part of April to the end of July, the peak being in May and early June. No immature specimens were seen during the breeding season, indicating that the fish matures during the first year. Periodical examination of the spent fish showed that the gonads remained quiescent during the rest of the season, suggesting that the fish breeds only once during the year.

Sexual dimorphism

The sexes in *O. bacaila* can be easily distinguished during the breeding season by the coloration of the body and the fins as follows :

Distinguishing characters	♂	♀
1. The lateral band on the body above the lateral line ..	less conspicuous	conspicuous and darker
2. Dorsal body coloration ..	pale green	darker
3. Ventral fins ..	pale yellow	white
4. Anal fin ..	pale yellow	white

Fecundity

The ripe ovary is pale grey in colour with ova of almost uniform size. The fully ripe ovum is translucent, nearly spherical in shape, with a diameter ranging from 0·612 to 0·663 mm.

The fecundity of eleven specimens ranging in length from 113 to 138 mm. was studied and the data are given in Table 1. The total number of ova ranged from 14,663 to 29,925.

TABLE 1

FECUNDITY DATA OF *O. bacaila*

Total length (mm.)	Total weight (gm.)	Weight of ovary (gm.)	Total No. of ova	No. of ova per gm. body weight	No. of ova per gm. ovary	Stage of ovary	Size of ova (mm.)
113	12·75	2·61	14,663	1,150	5,618	IV	0·510
113	14·75	3·80	16,956	1,136	4,462	IV	0·544
115	13·50	2·83	16,379	1,213	5,788	IV	0·510
117	16·75	4·20	17,917	1,069	4,266	V	0·663
120	16·50	3·16	17,904	1,058	5,666	IV	0·510
122	18·25	4·61	23,050	1,263	5,000	V	0·612
123	21·00	5·28	22,207	1,057	4,230	V	0·629
124	18·00	5·22	26,465	1,470	5,070	V	0·646
126	21·50	5·94	25,898	1,204	4,360	V	0·612
129	20·50	5·41	29,051	1,417	5,370	IV	0·527
138	22·50	6·30	29,925	1,330	4,750	V	0·663

It is seen that the fecundity increases with the increase in size of the fish. The number of ova per gramme weight of ovary ranged from 4,230 to 5,788. The number of ova per gramme body weight or the 'fecundity factor' ranged from 1,057 to 1,470 with an average of 1,219.

INDUCED BREEDING

A preliminary dose of 2 to 4 mg. of heteroplastic pituitary gland per kg. weight of the fish, followed, after four to six hours, by a second dose of 8 to 10 mg. per kg. was administered to the female and a single injection of 2 to 4 mg. per kg. was given to the male at the time of second injection for the female. The commencement of spawning is marked by active, excited movement of the breeders, the female being chased by the males. The process of spawning is intermittent and is completed in about thirty minutes.

As the eggs were observed to be adhesive, submerged aquatic weeds like *Najas*, *Ceratophyllum* and *Hydrilla* were provided as egg-collectors.

EMBRYONIC DEVELOPMENT

The adhesive eggs are spherical and demersal, when detached. In ponds, they were attached to submerged aquatic weeds and grasses or the bottom soil in shallow areas. The eggs are translucent and slightly greyish in colour when just laid. They swell up uniformly in fifteen to twenty minutes and become transparent. The fully swollen eggs have a fairly large perivitelline space and measure as follows :

		Range (mm.)	Average (mm.)
Diameter of outer shell	..	1·190-1·309	1·241
Diameter of egg proper	..	0·663-0·697	0·680

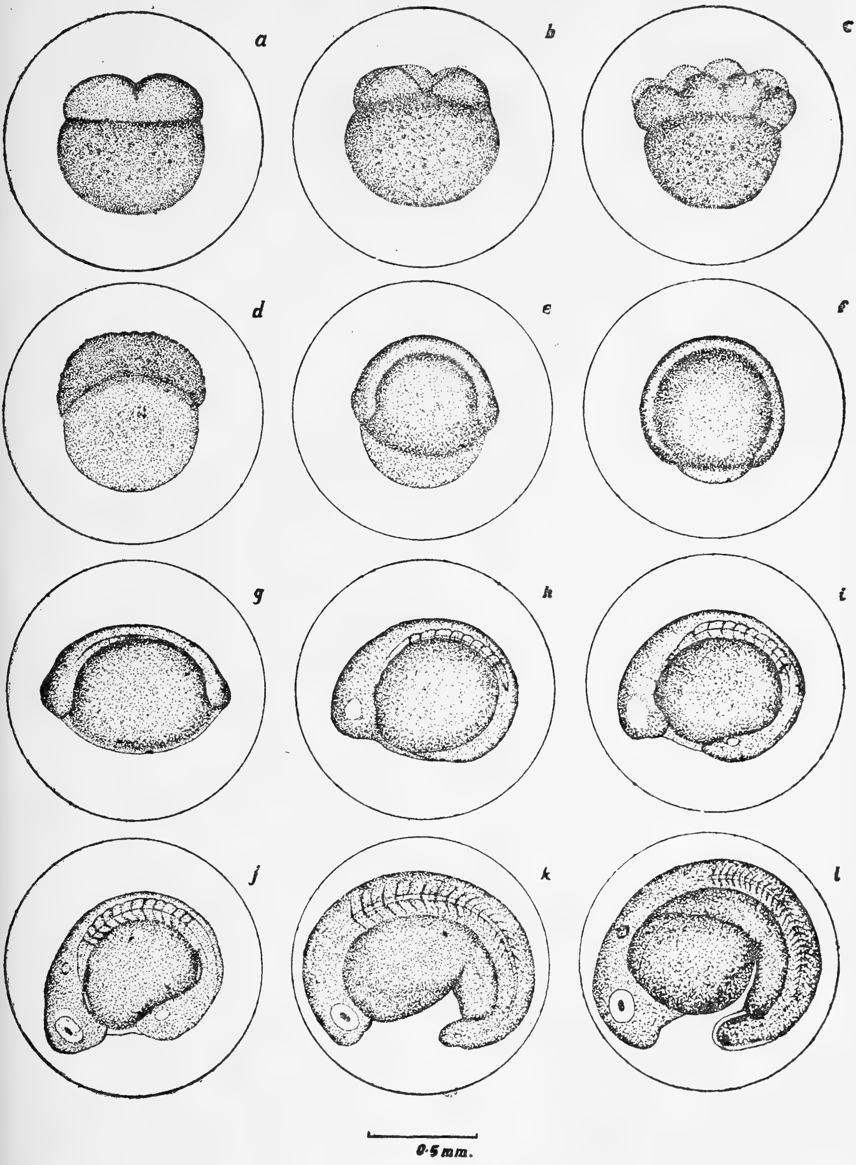
Cleavage (Text-fig. 1, *a-d*) *:* About twenty minutes after fertilisation, a crescentic, narrow blastodisc appears over one end of the yolk mass. The first cleavage occurs about thirty-three minutes after fertilisation. The second cleavage takes place seven minutes later, which is followed by the eight celled stage in the next six to seven minutes. The fourth cleavage occurs about fifty-two minutes after fertilisation and the thirty-two-celled stage follows in another four minutes. The morula cap is formed in one hour and seventeen minutes after fertilisation.

Differentiation of the embryo (Text-fig. 1, *e-l*) *:* The blastoderm cells begin to spread over the yolk mass, about a third of which is covered in another two hours. The yolk-plug stage is reached in about four hours and twenty-seven minutes after fertilisation. The yolk is completely invaginated by the blastoderm cells in the next twenty minutes and the embryonic rudiment is formed as a marginal, narrow, thickened band.

The embryo now starts elongation and when five hours and twenty minutes' old, measures $0{\cdot}969 \times 0{\cdot}663$ mm. The cephalic and caudal ends are now faintly discernible. The notochord has formed and two myotomes have appeared. In the next thirty minutes the cephalic and caudal ends become further differentiated and easily distinguishable and another two myotomes have been added.

The cephalic region becomes more prominent when the embryo is six hours and forty-five minutes' old. The rudiments of the optic vesicles have formed. Altogether, eight or nine myotomes have differentiated. About ten minutes later, the Kupffer's vesicle appears as an oval area in the caudal region.

In a seven hours and twenty minutes' old embryo the lens appears in the optic vesicles. About twelve to thirteen myotomes can be counted. The embryonic fin-fold appears around the elongated caudal end and its tip becomes free from the yolk mass. In another thirty minutes the yolk elongates and three more myotomes are added. The otoliths appear as two minute concretions in each otic vesicle. The embryo makes occasional twitching movements.



Text-fig. 1. Embryonic development of *Oxygaster bacaila* (Hamilton)

Fertilised egg (*a*) Two-celled stage, (*b*) Four-celled stage, (*c*) Eight-celled stage, (*d*) Morula stage, (*e*) Early gastrulation, (*f*) Yolk-plug stage; Embryo, (*g*) 5-50 hours old, (*h*) 6-45 hours old, (*i*) 6-55 hours old, (*j*) 7-20 hours old, (*k*) 8-00 hours old, (*l*) 10-00 hours old.

The Kupffer's vesicle becomes reduced in size in the eight hours' old embryo. The yolk becomes elongated and tapering. More myotomes differentiate. The embryo becomes longer and measures 1·394 mm. in length. It frequently moves and changes its position inside the egg shell.

Ten hours' old embryo has further elongated and it executes vigorous movements and almost fills up the entire perivitelline space. The heart pulsates. About twenty-four to twenty-six myotomes can be discerned. Kupffer's vesicle has disappeared. The anus is indicated. In the next four hours, ten to twelve myotomes are added and the embryos are ready for hatching. It takes about thirty minutes to one hour for the whole brood of eggs to hatch out.

At a water temperature range of 25·5 to 27·6°C, the period of incubation is fourteen to fourteen-and-a-half hours.

The larval and post-larval stages were reared in laboratory aquaria to study the subsequent differentiation of structures.

Larval Development

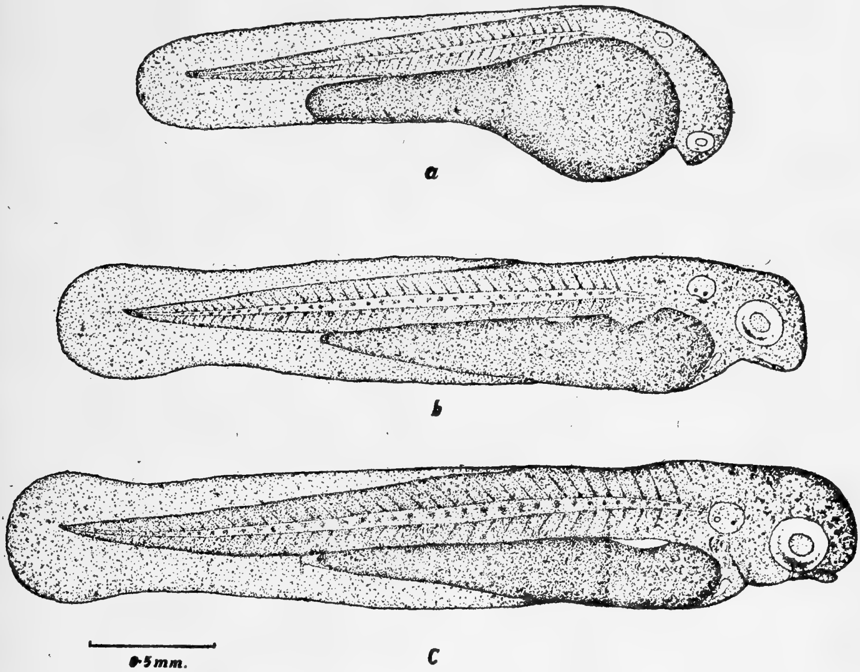
(Text-fig. 2, *a-c*)

Larva, just after hatching : The hatchling is slender, small, almost transparent and without mouth, pectoral fins and body pigmentation, excepting for a small dark spot on the ventral aspect of the eye. The otic vesicles are oval in shape and the concretions inside them are of almost same size. The embryonic fin-fold extends up to about two-thirds of the body. It is broader around the caudal end and extends ventrally beyond the vent, up to the middle of the body. The anus is situated far back and the post-anal length is about one-fourth the total length. There are about thirty-seven to thirty-eight myotomes, of which twenty-seven are pre-anal in position. The yolk-sac is broad anteriorly and tapers towards the vent. The larva lies quiescent on its side in the bottom and occasionally moves about for some time.

Larva, twelve hours after hatching : The buccal invagination is indicated. The pectoral fin buds and the rudiment of the swim-bladder have formed. The otic vesicles become rounded.

Larva, twenty-four hours after hatching : The yolk-sac becomes thinner. The lower jaw is formed and the mouth is subterminal. Two to four melanophores appear on the head. The pectoral fins become flap-like and the larva freely swims about in water. The otic vesicles become more rounded and of the two concretions inside, the posterior one becomes slightly larger in size.

Larva, forty-eight hours after hatching : Twelve to fifteen melanophores appear on the head. A line of melanophores forms just above the yolk-sac, extending up to the caudal peduncle. The eyes are fully pigmented. The swim-bladder enlarges in size. The yolk-sac becomes very thin and ceratotrichia appear in the caudal fin.



Text-fig. 2. Larval stages of *Oxygaster bacaila* (Hamilton)
Larva (*a*) Just hatched out, (*b*) 12 hours old, (*c*) 24 hours old.

The average body measurements of the different larval stages described are given in Table 2.

TABLE 2

BODY MEASUREMENTS OF THE LARVAL STAGES DESCRIBED

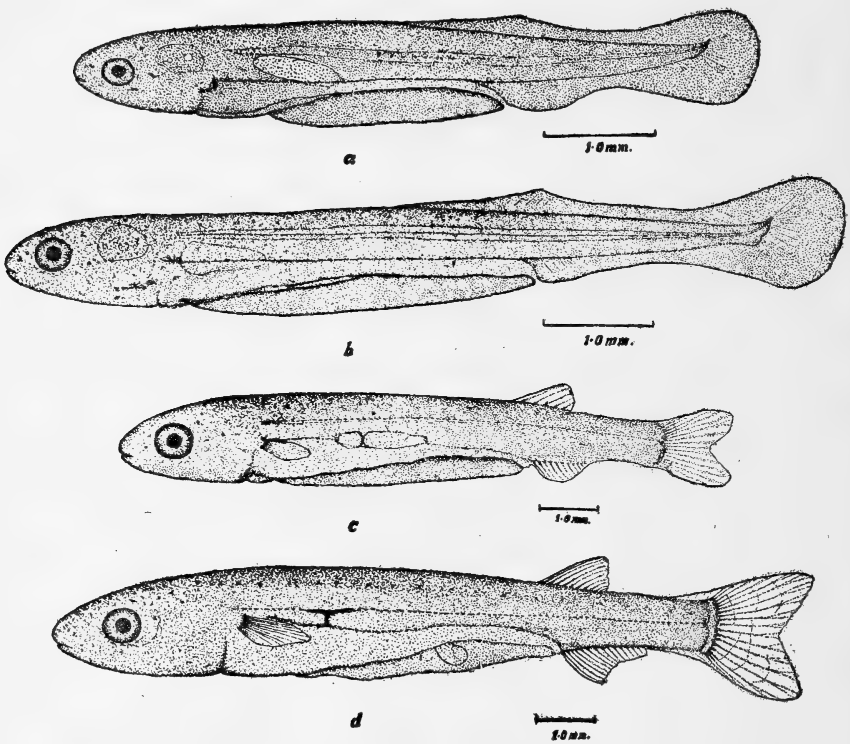
Average measurements of body parts in mm.	*Age in hours after hatching*			
	0*	12	24	48
Total length	2·482	3·111	3·519	3·970
Post-anal length of body ..	0·578	1·058	1·165	1·271
Maximum height of body ..	0·714	0·544	0·527	0·476
Length of yolk-sac	1·598	1·962	1·751	1·630
Maximum height of yolk-sac ..	0·680	0·323	0·255	0·187

* Just hatched

Post-Larval Development

(Text-fig. 3, *a-d*)

Post-larva, two-and-a-half days' old (4·267 *mm. in length*) *:* The yolk is completely absorbed and the larva starts to feed. The alimentary canal is straight. The number of melanophores has increased on the head. In addition to the line of melanophores on the ventral aspect of the myotomes, another line appears on the middle, each myotome having one melanophore. In the otic vesicle, the posterior concretion is about double the size of the anterior one. The larval fin-fold is continuous.



Text-fig. 3. Post-larval stages of *Oxygaster bacaila* (Hamilton)

Post-larva (*a*) 5·988 mm. in length, (*b*) 7.330 mm. in length, (*c*) 10·495 mm. in length, (*d*) 12·910 mm. in length.

Post-larva, four days' old (5·998 *mm. in length*)*:* The embryonic dorsal fin-fold broadens at a level slightly posterior to the vent, indicating the formation of the dorsal fin. A similar broadening of the ventral fin-fold, posterior to the vent, indicates the position of the anal fin. The tip of the notochord is slightly upturned. The hypurals form as thickenings of the caudal fin and the rays are faintly indicated. More melanophores appear all over the body. The mouth becomes terminal and slightly upturned. The larva becomes opaque and the internal structures are not visible.

Post-larva, six days' old (7·330 *mm. in length*) *:* The body pigmentation has further accentuated. The dorsal and anal fins are still continuous with the larval fin-fold and four rays can be discerned in each. In the caudal fin, which is rounded, about twelve rays appear.

Post-larva, nine days' old (10·495 *mm. in length*) *:* The full compliment of rays form in the pectoral fins. In the slightly forked caudal fin, seventeen rays have appeared. The dorsal fin is almost free from the larval fin-fold and has four to five rays. The anal fin is continuous with the ventral fin-fold posteriorly and has nine to ten rays.

Post-larva, eleven days' old (12·910 *mm. in length*) *:* The caudal fin rays have three articulations. The embryonic dorsal fin-fold, anterior to the caudal fin, has not atrophied fully. The dorsal fin has ten rays. The anal fin is free and has developed fourteen rays. Scales appear all over the body. The swim-bladder has constricted into two. Ventral fin buds form. The larva resembles the adult in general appearance.

Post-larva, fourteen days' old (16·910 *mm. in length*) *:* The full compliment of rays have formed in the anal and ventral fins. The pre-anal fin-fold is reduced in size. More melanophores appear all over the body.

Post-larva, seventeen days' old (20·640 *mm. in length*) *:* The pre-anal fin-fold completely disappears. The ventral fins acquire adult shape. The larva attains the form and shape of the adult in all details.

In Table 3, the average measurements of the different body parts of the larval stages described in the text are given.

TABLE 3

AVERAGE BODY MEASUREMENTS OF THE POST-LARVAL STAGES

Average measurements of body parts in mm.	*Age in days*						
	2½	4	6	9	11	14	17
Total length	4·267	5·998	7·330	10·495	12·910	16·910	20·640
Length of head	0·668	1·193	1·560	2·376	2·975	3·850	4·261
Post-anal length of body	1·395	2·059	2·630	3·488	3·990	6·670	8·490
Maximum height of body	0.519	0·716	0·925	1·372	1·877	2·286	2·830

NOTES ON FOOD AND FEEDING HABITS

Smaller post-larvae (4 to 8 mm. in length ; reared in laboratory) fed mostly on small rotifers and phyto-plankters like *Microcystis*, *Anabaena*, *Euglena*, *Trachelomonas* and desmids. The larger post-larvae (9 to

20 mm. in length) and juveniles (21 to 40 mm. in length) fed mainly on zoo-plankters (67.4 per cent). Phytoplankters constituted the next important item (23·8 per cent) and the balance was made up by debris. The dominant groups of zoo-plankters encountered were rotifers (*Brachionus, Polyarthra, Keratella, Monostyla, Pedalia* and *Asplanchna*), cladocerans (*Moina, Bosmina* and *Ceriodaphnia*) and copepods (*Diaptomus, Cyclops*) and nauplii and phyto-plankters consisted of blue-green algae (*Microcystis, Anabaena* and *Oscillatoria*), green algae (*Cosmarium, Staurastrum, Arthrodesmus* and *Spirogyra*) and euglenoids (*Euglena, Phacus* and *Trachelomonas*). The phytoplankters encountered in the guts appear to have been consumed accidentally along with zoo-plankters and may not be of any food value to the fish as they pass through the gut without getting digested.

The adult fish (41 to 149 mm. in length) fed mainly on zoo-plankton (60·9 per cent) as was found in the case of larger post-larvae and juveniles. The other items found in the guts were filamentous algae (*Spirogyra, Anabaena* and *Oedogonium*, 19·2 per cent), aquatic insects (mostly small water bugs, 14·4 per cent) and some debris (5·5 per cent). Most of the guts examined were over '50 per cent full' to 'gorged' with food, empty guts being rarely encountered, indicating thereby that the feeding intensity of the fish is fairly high.

Discussion

Oxygaster bacaila is reported to attain a length of 178 mm. However, the largest specimen in the present collection measured only 149 mm.

O. bacaila, like the majority of 'weed' fishes, breeds in ponds in Assam from late April, almost with the onset of monsoon rains, and the breeding season extends till the middle of July. This is in contrast to that of *O. phulo* in Orissa, which is reported to have its peak spawning period just before the monsoon season (Alikunhi & Chaudhuri 1954). According to Qasim & Qayyum (1962), in northern India the breeding season of *O. bacaila* is from June to September and the peak spawning is in August. Thus, the fish matures and breeds about two months ahead in Assam, compared to northern India. This is presumably due to the early onset of monsoon in Assam, where major carps also have been observed to become mature and breed from the end of March onwards (Parameswaran *et al.*, unpublished data).

Sexual dimorphism as observed in *O. bacaila*, described earlier, occurs in *O. phulo* (Alikunhi & Chaudhuri loc. cit.), *O. argentea* and *O. untrahi* (Chacko *et al.* 1946).

The ripe ovarian eggs of *O. bacaila* are larger in diameter than those of *O. phulo* and are comparable to those of *O. gora* (Alikunhi &

Chaudhuri loc. cit.). The ovarian eggs of *O. untrahi* (Chacko 1951) are larger than those of *O. bacaila*.

The 'fecundity factor' of *O. phulo* (calculated from Alikunhi & Chaudhuri loc. cit.) ranges from 689 to 1,062, the average being, 804·5. Comparatively, the fecundity of *O. bacaila* is high.

A comparison of the embryonic and larval stages of *O. bacaila* and *O. phulo* (Alikunhi & Chaudhuri loc. cit.) is of some interest. The fertilised eggs of *O. bacaila* are larger in size compared to those of *O. phulo*, which measure 0·675 to 0·727 mm. in outer diameter and 0·476 to 0·485 mm. in inner diameter. In both species the eggs are adhesive, spherical and transparent. The period of incubation of *O. phulo*, at a water temperature ranging from 29·3 to 33·3°C. is about twelve hours. In *O. bacaila* also the incubation period is almost same in this temperature range and the hatchlings are in the same stage of differentiation. However, the hatchlings of the two species can be distinguished by the smaller size (2·025 mm.) and the larger number of myotomes (42, of which 25 are pre-anal) in *O. phulo*. The post-larva of *O. phulo*, with all the structures fully formed, measures 16 to 17 mm. in length and is thus decidedly smaller when compared to the same stage in *O. bacaila*.

Alikunhi & Chaudhuri (loc. cit.) have stated that *O. phulo* 'generally subsists on a predominantly zoo-plankton diet but also feeds on non-planktonic bottom living forms like *Spirogyra*, aquatic insects etc., in the absence or paucity of zoo-plankton'. The same appears to be substantially true in the case of *O. bacaila* also. The slightly up-turned mouth also probably indicates the plankton feeding habit of the fish. The food habits of the species are at variance with those of *O. argentea*, which feeds on planktonic algae (Chacko *et al.*, loc. cit.) and *O. gora* which feeds mainly on fish (Sehgal & Singh 1962).

The present study indicates that, as observed by Alikunhi & Chaudhuri (1954), *O. bacaila* also competes for food with major carp fry in nurseries and its food habits are incompatible with those of *Catla catla* in the adult stage. Hence, careful eradication of the species from fish ponds is desirable for ensuring better growth of the cultivable stock in them.

Acknowledgements

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Leaf-feeding caterpillars of Paddy and their natural enemies in India[1]

BY

V. P. Rao, M. J. Chacko, V. R. Phalak and H. Dinesh Rao

Commonwealth Institute of Biological Control, Indian Station, Bangalore

(*With twenty-two text-figures*)

A number of species of leaf-feeding caterpillars are minor pests of paddy some of which feed only occasionally on the crop. Although they do not usually cause serious damage, some species like *Cnaphalocrocis medinalis* Guénée, *Nymphula depunctalis* Guénée, *Pelopidas mathias* (Fabricius), *Spodoptera mauritia* Boisduval, and certain hairy caterpillars like *Psalis pennatula* (Fabricius) and *Laelia fasciata* Moore cause mild to severe damage.

An extensive survey was conducted from July 1961 to July 1964 in different areas in India for natural enemies of pests of paddy. Among the many pests observed were 26 species of leaf-feeding Lepidoptera (listed below in alphabetical order of the families), several of which were recorded on paddy for the first time in India while a few others were first records on the crop.

A number of natural enemies of these caterpillars were also recorded during the present survey, many for the first time on these pests while others were new records for India. The observations made are given in the following pages.

1. **Creatonotus gangis** Linnaeus (Arctiidae)

This was observed feeding on paddy at Mahadanapuram (Tamil Nadu) in 1962, and is a new record for India. Walker (1961) lists this as a pest of paddy, but he has not mentioned the country where it had been recorded. The larvae of *C. gangis* are black and hairy. *Drino* (*Prosturmia*) sp. (Diptera : Tachinidae) was reared from this pest.

2. **Ampittia dioscorides** Fabricius (Hesperidae)

This was found at Ernakulam (Kerala) in 1963. It resembles the larva of *Pelopidas mathias* (Fabricius) (Lepidoptera : Hesperidae) but

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has a black head and a black patch on the dorsal side of the last abdominal segment. *Apanteles baoris* Wilkinson (Hymenoptera : Braconidae), *Rhysipolis hesperidis* Rohwer (Hymenoptera : Braconidae) (new host record), *Labrorychus* sp. (Hymenoptera : Ichneumonidae) and *Halidaya luteicornis* (Walker) (Diptera : Tachinidae) were reared from the caterpillars, and *Xanthopimpla* sp. (Hymenoptera : Ichneumonidae) from the pupae. *R. hesperidis* was described by Rohwer (1918) under the genus *Onchophanes* from Java, having been reared from an unidentified Hesperid larva.

3. **Pelopidas (Parnara) mathias** (Fabricius) (Hesperidae)

The ' paddy-skipper ' *P. mathias* is a minor pest and causes only mild damage to the crop. However, in some localities it assumes pest status under certain conditions. In 1963 it was the chief pest in paddy nurseries at Gauhati (Assam). In Kerala it was prevalent on autumn crop from June to August, 1963 and in the absence of paddy it fed on grass growing on the field bunds. A severe infestation was noticed at Tiruvarur (Tamil Nadu) in 1963. In West Bengal infestation was relatively high in several localities in August 1963 ; a mild infestation was noticed on *Sorghum vulgare* Pers. in June 1963 at Baidyabati (West Bengal).

Thompson (1944-47) has listed 16 species of parasites on *P. mathias.* During the course of the present survey 1 egg parasite, 33 species of larval parasites, 1 larval predator and 7 species of pupal parasites were recorded on *P. mathias.* These were :

Egg Parasite

HYMENOPTERA

Proctotrupoidea

SCELIONIDAE

1. **Telenomus** sp.—Kalamassery and Thevara (Kerala State) in 1963 ; parasitism negligible.

Larval Parasites

HYMENOPTERA

Chalcidoidea

ELASMIDAE

2. **Elasmus** sp.—(first record on this host in India) ; Kottapuram (Kerala), 1963 ; Madapuram (Tamil Nadu), August 1962.

EULOPHIDAE

3. **Euplectrus nyctemerae** Crawford—(new record) ; Kalamassery, 1963. This has been recorded earlier on *Nyctemera lacticinia* Cram. (Lepidoptera : Hypsidae) in India (Ayyar 1921).
4. **Sympiesis** sp.—(new record) ; Kalamassery, 1963. A *Sympiesis* sp. was found to parasitise *Parnara guttata* Brem. in China (Chu 1934).

EURYTOMIDAE

5. **Eurytoma manilensis** Ashmead—(new record); Khanapara (Assam), December 1963 (possibly as a secondary parasite); Amausi (Uttar Pradesh), October and November 1962 and 1963.

PTEROMALIDAE

6. **Eupteromalus** sp.—Lucknow (Uttar Pradesh), possibly as a secondary parasite in October and November 1962. Corbett & Miller (1933) report it as a parasite of *P. mathias* in Malaya.

Ichneumonoidea

BRACONIDAE

7. **Apanteles** sp. apparently new—Shillong (Assam), July to October 1963.
8. **Apanteles** sp.—Shillong, July to October 1963; Adiyakkamangalam and Vaduvancheri (Tamil Nadu), 1962; Bangalore (Mysore State); Dalhousie (Himachal Pradesh), 23% parasitism in August and September 1963; Lucknow, October and November 1962 and 1963.
9. **Apanteles agilis** Ashmead—Chamba (Himachal Pradesh), 1963.
10. **Apanteles baoris** Wilkinson—Bodhan (Andhra Pradesh), August to September 1963; Gauhati, August 1963, Jorhat (Assam), October 1963, Shillong, July to October 1963; Alwaye (Kerala), Ernakulam and Kalamassery, July and August 1963; Tiruvarur, September to November 1963, 10% parasitism; Bangalore, Mandya (Mysore State); Bhubaneswar (Orissa), Itonja (Uttar Pradesh); Baidyabati, August 1963, 33% parasitism. *A. baoris* was first recorded in Malaya on *P. mathias* (Wilkinson 1930).
11. **Apanteles javensis** Rohwer—(new host record); on *P. mathias* on autumn crop at Ernakulam and Kalamassery. This parasite, described by Rohwer (1918) from Java, was reared from *Parnara conjuncta* H. S. Bhatnagar (1948) lists *A. javensis* as a parasite of the same host in India. Therefore it is a first record on *P. mathias* for India.
12. **Apanteles ruficrus** Haliday—(new host record); Bhubaneswar, August to September 1962; Itonja, 1962 and 1963. In India it attacks *Spodoptera mauritia* Boisduval, *Heliothis armigera* Hübner (Lepidoptera : Noctuidae), *Hypsipyla robusta* Moore (Lepidoptera : Phycitidae) and other Noctuidae (Beeson & Chatterjee 1935).
13. **Bracon** sp.—Gauhati (1962), Shillong, September 1962; Mahadanapuram, Tiruvarur, August 1962; Bhubaneswar, August and September 1962.
14. **Bracon alguei** Ashmead—(Text fig. 1) (new host record); Kalimpong (West Bengal), 1963. Ashmead (1905) describes it from the Philippines, but there is no mention of its host.
15. **Bracon gelechiae** Ashmead—(new host record); Ernakulam, 1963; Tiruvarur, Vedagam (Tamil Nadu), September 1963, 4% parasitism; Amausi; Bandel and Talandoo (West Bengal), September 1963. *B. gelechiae* was introduced into India from Canada in 1944 (Isaac 1944-45) for the control of the potato tuber moth *Gnorimoschema operculella* (Zeller) (Lepidoptera : Gelechiidae). Records of its field releases are not available, but it has been learnt informally that the parasite had been released in the potato godowns and fields in Bihar. A detailed study of this parasite has been made by Narayanan & Subba Rao (1955).
16. **Iphiaulax** sp.—Bodhan, 1963.

17. **Rhysipolis** sp.—apparently new—Shillong, October 1963.
18. **Rhysipolis** sp.—Kotahari and Madapuram (Tamil Nadu).
19. **R. hesperidis** (Rohwer)—Bodhan, August to September 1963 ; Burnihat (Assam), Gauhati, 1963, and Jorhat, October 1963 ; Ernakulam, Kalamassery, Thodupuzha (Kerala) where it was very common in July 1963 ; Katoor (Tamil Nadu), 45% parasitism, Kotahari, and Laxmangudi (Tamil Nadu), September 1962 ; Mandya ; Bhubaneswar, August and September 1963, 40 to 50% parasitism ; Lucknow ; Baidyabati, September 1963. This is the first record of the parasite in India and on *P. mathias.*

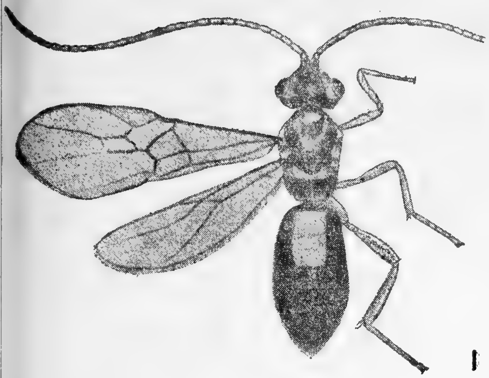
ICHNEUMONIDAE

20. **Campoletis** sp.—(new record) ; Shillong, July to October 1963.
21. **Charops** sp.—Bangalapukhuri (Assam), 1963 ; Aduthurai (Tamil Nadu), November 1963, parasitism negligible.
22. **Charops bicolor** (Szépligeti)—(Text-fig. 2) (first record in India and on this host) ; Bodhan, August and September 1963 ; Gauhati and Jorhat, 1963, Shillong, July to October 1963 ; Alwaye, Ernakulam and Kalamassery, 1963 ; Tiruvarur, September to November 1963, 24% parasitism ; Bhubaneswar, August and September 1963, 30% parasitism ; Lucknow ; Baidyabati and Bandel, heavy parasitism in 1963. *C. bicolor* was described from Ceylon by Szépligeti in 1906 under the genus *Argypon* (Townes *et al.* 1961) and is known to attack *Naranga aenescens* Moore in China and Taiwan.
23. **Nythobia** sp.—(new record) ; Shillong, July to October 1963.
24. **Scenocharops** sp.—(new record) ; Shillong, July to October 1963.
25. **Hemitelini** Gen. & sp. ?—Shillong, July to October 1963.
26. **Hemitelini** Genus near **Paraphylax**—Shillong, 1963.

DIPTERA

TACHINIDAE

27. **Actia** sp.—(new record) ; Alwaye, Ernakulam, Kalamassery, 1963 ; Lucknow ; Baidyabati, August to October 1963.
28. **Actia (Ceromyia) perispoliata** Mesnil—(new record) ; Kalamassery, 1963.
29. **Argyrophylax nigrotibialis** Baranov (=*simulator* Mesnil)—(new record) ; Shillong, September to November 1962, 5% parasitism ; Chauvara (Kerala), Kalamassery and Thodupuzha, 1963 ; Madapuram, August 1962, heavy parasitism ; Dalhousie, August to September 1963 ; Lucknow ; Chandannagar (West Bengal), August to October, 1962. In Malaya this parasite attacks *Spodoptera mauritia* (Corbett & Miller 1933).
30. **Drino unisetosa** Baranov—(new host record) ; Bangalore.
31. **Halidaya luteicornis** (Walker)—Jorhat, October 1963 ; Shillong, July to October 1963 ; Alwaye, Ernakulam, Kalamassery, Palluruthy (Kerala), July 1963, up to 50% parasitism ; Tiruvarur, September to November 1963, 36% parasitism ; Bangalore ; Bhubaneswar, August and September 1963, up to 50% parasitism ; Dalhousie, August and September 1963 ; Baidyabati, Bandel, Bhadreswar (West Bengal), Triveni (West Bengal), July to end of October 1963, parasitism 52%. Thompson (1944-47) lists it as a parasite of *P. mathias* in India.
32. **Spoggosia acuminata** Rd. ssp. **bezziana** Bar.—(new record) ; Sirpur (Orissa), September 1963. This parasite had been originally introduced from



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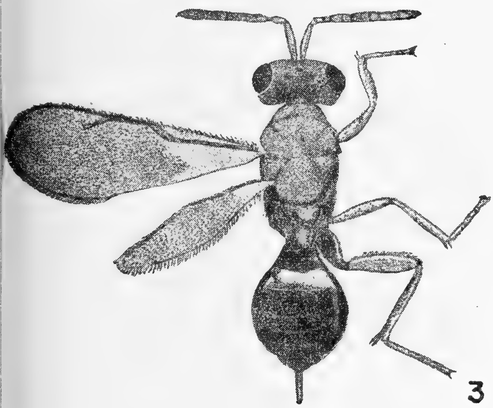

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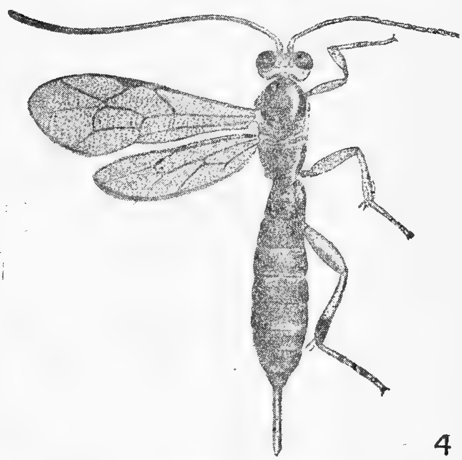

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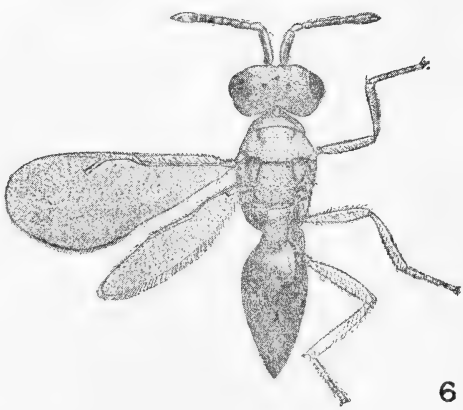

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Text-figs. 1. *Bracon alguei* Ashmead (× 16) Ex : *Pelopidas mathias* (F.), Kalimpong; 2. *Charops bicolor* (Szép.) (× 6) Ex : *P. mathias*, Ernakulam; 3. *Eupteromalus parnarae* Gahan (× 20) Ex : *P. mathias*, Kannamali; 4. *Itoplectis* sp. nr. *maculator* Fabr. (× 6) Ex : *P. mathias*, Shillong; 5. Genus nr. *Coelichneumon* (× 3) Ex : *P. mathias*, Shillong; 6. *Trichomalopsis apanteloctenus* (Crawford) (× 19) Ex : Cocoon of *Apanteles* sp. on *P. mathias*, W. Bengal.

Ceylon by the senior author for trial against the coconut caterpillar *Nephantis serinopa* Meyr. (Lepidoptera : Cryptophasidae) and subsequently introduced into Orissa for use against the same pest. This is the first time that it has been reared from *P. mathias*.

33. **Thecocarcelia oculata** Baranov—(new record) ; Pothangal (Andhra Pradesh), September 1963 ; Chamba, 1963 ; Madapuram, Mahadanapuram ; Bhubaneswar, 1963 ; Triveni, August to October, parasitism negligible.
34. **Thecocarcelia** sp. nr. **thrix** T.T.—(new record) ; Bandel, September 1963.

Pupal Parasites

HYMENOPTERA

Chalcidoidea

CHALCIDIDAE

35. **Brachymeria euploeae** (Westwood)—(new host record) ; Kalamassery, Kannamali (Kerala), 1962 ; Bhubaneswar. In India it has been recorded from *Diacrisia obliqua* Walker (Lepidoptera : Arctiidae) and *Pyrausta nubilalis* (Hb.) (Thompson 1944-47). However, the occurrence of *O.* (=*Pyrausta*) *nubilalis* in India appears doubtful because of the fact that all the later collections of *Ostrinia* in India* have been determined as *Ostrinia kasmirica* (Moore).

EULOPHIDAE

36. **Tetrastichus** sp.—Bhubaneswar.

PTEROMALIDAE

37. **Eupteromalus parnarae** Gahan—(Text-fig. 3) Kannamali, 1962 and 1963. *E. parnarae* described by Gahan (1919) from India was reared from *P. mathias* as a primary parasite. This has been recorded as a secondary parasite also on *P. mathias* through other parasites.

Ichneumonoidea

ICHNEUMONIDAE

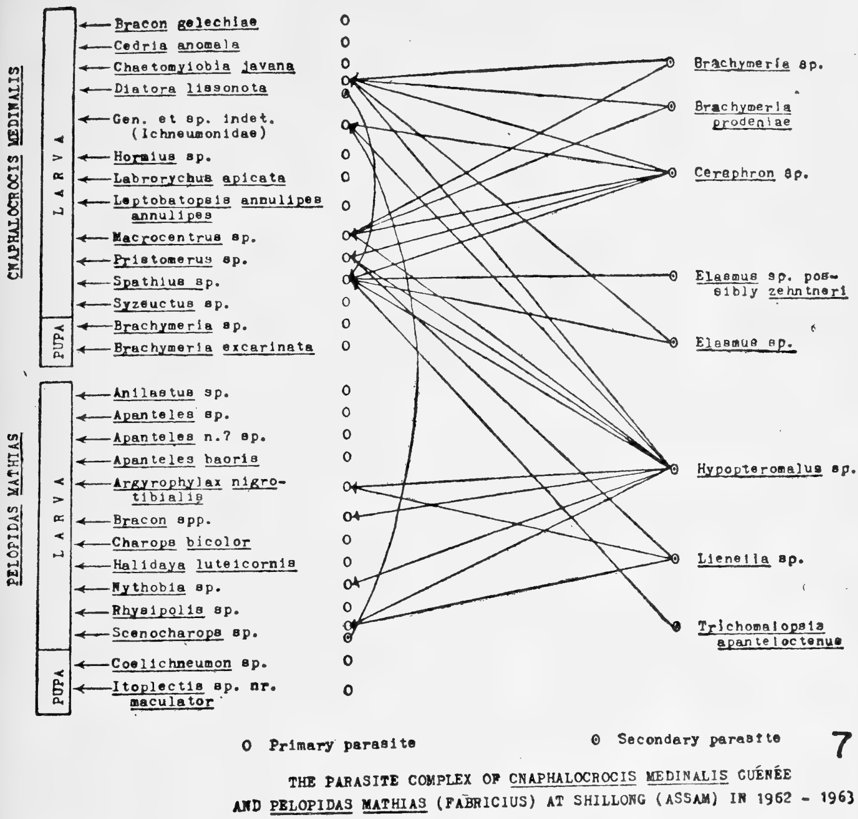
38. **Ischnojoppa luteator** Fabricius—Kalamassery, Kannamali, 1962 and 1963 ; Bhubaneswar. Ayyar & Margabandhu (1934) have recorded it on this host in India.
39. **Itoplectis** sp. nr. **maculator** Fabr.—(Text-fig. 4) (new record) ; Shillong, September to November 1962, 2% parasitism.
40. **Xanthopimpla** sp.—Alwaye, Ernakulam and Kalamassery, 1962 ; Bhubaneswar.
41. Genus nr. **Coelichneumon**—(Text-fig. 5) (new record) ; Shillong, January 1964.

Secondary Parasites

Eurytoma sp. and *E. parnarae* were reared from the pupae of the Braconids at Bodhan. At Shillong the efficacy of *Argyrophylax nigrotibialis* was considerably reduced by the activity of *Hypopteromalus* sp. (Hymenoptera : Pteromalidae), *Lienella* sp. (Hymenoptera : Ichneumonidae), and an unidentified Ichneumonid which attacked the pupae ; *Trichomalopsis apanteloctenus* (Crawford) (Hymenoptera : Pteromalidae) (Text-fig. 6) and *Eurytoma* sp. were recorded as secondary parasites of *P. mathias* through pupae of unidentified species of primary parasites ; *Hypopteromalus* sp. was

* Commonw. Inst. Biol. Control, Report for 1967.

also obtained from the pupae of *Bracon* spp., *Nythobia* sp. and *Scenocharops* sp. (see Text-fig. 7 : Parasite Complex). At Ernakulam *T. apanteloctenus* was reared from the pupae of *H. luteicornis* and *Charops bicolor* ; about 5% of the pupae of *Halidaya*



Text-fig. 7. Parasite complex of *Cnaphalocrocis medinalis* Gn. and *P. mathias* at Shillong

luteicornis were parasitised in July 1963. *Brachymeria* sp. from pupae of *Bracon* sp. and *C. bicolor*, *E. parnarae* from pupae of *Apanteles baoris* and *Bracon* sp. and *T. apanteloctenus* from pupae of *H. luteicornis* and *C. bicolor* were reared at Tiruvarur. At Bhubaneswar *Derostenus* sp. (Hymenoptera : Eulophidae) attacked the pupae of *Apanteles ruficrus*, and *E. parnarae* those of *Bracon* sp., while about 10% of the pupae of *Rhysipolis hesperidis* were parasitised by *Tetrastichus* sp. and about 25% of the pupae of *C. bicolor* by *Eupteromalus* sp. and *T. apanteloctenus*. In West Bengal *Brachymeria* sp. and *T. apanteloctenus* were reared from pupae of *C. bicolor* in 1963 ; *T. apanteloctenus* heavily parasitised *A. baoris* towards the end of August 1963 ; *Brachymeria* sp. parasitised *A. nigrotibialis* also, while *T. apanteloctenus* parasitised *R. hesperidis* ; *B. euploeae* and *Eupteromalus* sp. were reared from the pupae of *H. luteicornis*.

4. **Telicota ohara** Plötz (Hesperidae)

The larvae, which resemble those of *P. mathias*, were obtained in small numbers on paddy at Hooghly (West Bengal) in October 1963. This was the first record of this insect on paddy. The larvae were free from parasitism.

5. **Metanastria** sp. (Lasiocampidae)

The hairy caterpillars were collected at Budanoor (Mysore State) in 1963. No parasites were reared.

6. **Parasa bicolor** Walker (Limacodidae)

The 'paddy slug caterpillar' *P. bicolor* was observed as a minor pest of paddy at Gauhati. At Kamalpur (Assam) the caterpillars were observed along with paddy stem-borers in the root zone of paddy stubbles in June 1962. They pupated in November and adults emerged by the middle of May. The pest is a new record for India, the only other record of it as a pest of paddy being that from Indonesia (Walker 1961).

7. **Euproctis virguncula** Walker (Lymantriidae)

The caterpillars were collected in small numbers in the Punjab and Himachal Pradesh. This is the first record of *E. virguncula* as a pest of paddy in India. Walker (1961) has listed it as a pest of paddy in Indonesia. *Apanteles* sp. at Bathri and Chamba (Himachal Pradesh) (34% parasitism), *Carcelia modicella* (Wulp.) (Diptera : Tachinidae) (new host record) at Lucknow, *Exorista sorbillans* Wied. (Diptera : Tachinidae) (new host record) at Kalli in Uttar Pradesh were reared from the larvae in 1963.

8. **Laelia fasciata** Moore (Lymantriidae)

This pest was observed at Chowki (Assam) and around Chandannagar and Khanyan (West Bengal) in small numbers. No parasites were obtained at Chowki, while *Carcelia frontalis* Baranov (Diptera : Tachinidae) (new host record) was reared from the larvae at Chandannagar and *Xanthopimpla immaculata* Morl. from the pupae at Khanyan in 1963.

9. **Laelia lilacina** Moore (Lymantriidae)

This Lymantrid was collected at Ernakulam in small numbers and this was the first record of this pest on paddy. *Exorista sorbillans* was reared in February 1962; it was the first record of the parasite from India.

10. **Psalis pennatula** (Fabricius) (Lymantriidae)

This was obtained in small numbers in the States of Andhra Pradesh, Kerala, Tamil Nadu, Mysore, Orissa, Uttar Pradesh and West Bengal. In Kerala the infestation in general was moderate ; the pest was found all the year round in 1963. In the absence of paddy it fed on *Cyperus rotundus* L. at Ernakulam.

Two species of egg parasites, 12 species of larval and 4 species of pupal parasites were recorded. They were :

Egg Parasites

HYMENOPTERA

Proctotrupoidea

SCELIONIDAE

1. **Telenomus (Aholcus)** sp. apparently new—(new record) ; Aduthurai, 1963 and 1964.
2. **Telenomus** sp.—Chottanikara (Kerala) and Palghat (Kerala), 1963.

Larval Parasites

HYMENOPTERA

Ichneumonoidea

BRACONIDAE

3. **Apanteles** sp.—Ernakulam.
4. **Apanteles flavipes** Cameron—Bhubaneswar, 1963 and 1964. This species parasitises many species of sugarcane and rice stem-borers in a number of countries (Rao 1965).
5. **Microplitis** sp. apparently new—(Text-fig. 8) (new record) ; Ernakulam, Kalamassery.
6. **Microplitis carinicollis** (Cameron)—(new record) ; Kalamassery.

ICHNEUMONIDAE

7. **Charops bicolor**—Edapalli (Kerala).

DIPTERA

TACHINIDAE

8. **Carcelia** sp.—Bodhan, 1964 ; Tiruvarur, up to 35% parasitism in 1963.
9. **C. frontalis**—(new host record) ; Sirpur, 1963 and 1964.
10. **C. modicella**—Sirpur.
11. **Carcelia sumatrana** Townsend—(new host record) ; Mandya, October 1962 ; Ismail Gunj (Uttar Pradesh) and Lucknow.
12. **Carcelia** sp. ? **buitenzorgiensis** Baranov—Sirpur, 1963 and 1964.
13. **Carcelia** sp. ? **tritenzorgiensis** Baranov—(first host record) ; Bhubaneswar, August 1962.
14. **Exorista** sp.—Mandya, October 1962.

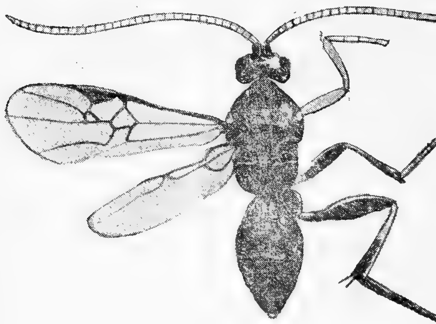
Pupal Parasites

HYMENOPTERA

Chalcidoidea

CHALCIDIDAE

15. **Brachymeria** sp.—Kalamassery, 1963 ; Bhubaneswar, 1963 and 1964.



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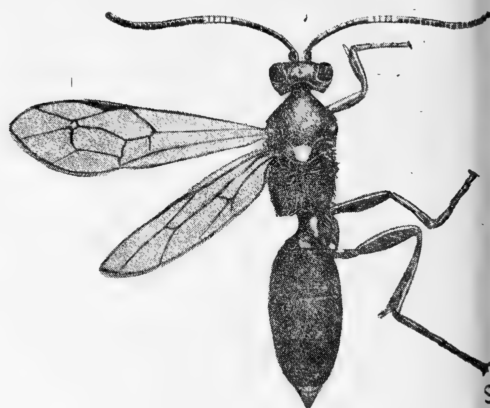

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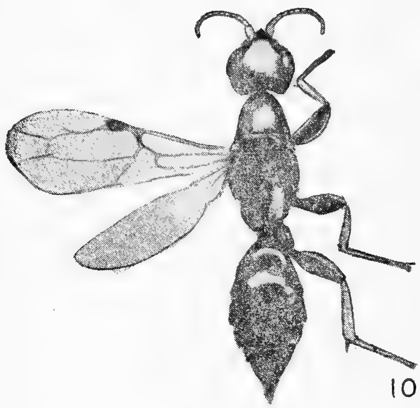

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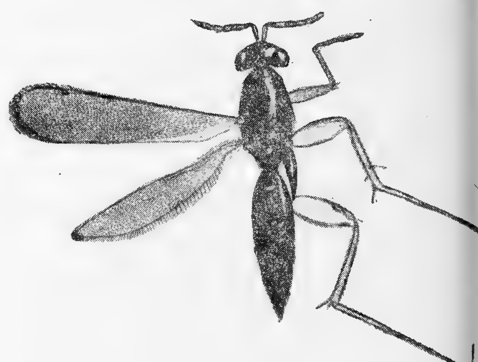

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Text-figs. 8. *Microplitis* sp. (× 6) Ex : *Psalis pennatula* (F.), Ernakulam ; 9. *Cratichneumon* sp. (× 4) Ex : *Pseudaletia separata* Walk., Jorhat ; 10. *Goniozus* sp. nr. *depressus* Kieffer (× 15) Ex : *C. medinalis*, Memari ; 11. *Elasmus* sp. b (× 18) Ex : *C. medinalis*, Sirpur

Ichneumonoidea

ICHNEUMONIDAE

16. **Enicospilus** sp.—(new host record) ; Kalamassery, 1963.

17. **Xanthopimpla** sp.—Bhubaneswar, 1963 and 1964.

DIPTERA

TACHINIDAE

18. **Carcelia** sp. ? **modicella** (Wulp.)—(new host record) ; Sikkal (Tamil Nadu) May 1962.

Secondary Parasites

Pupae of *C. bicolor* and *Microplitis* sp. were occasionally parasitised by an unidentified parasite at Edapalli. At Tiruvarur *Brachymeria* sp. parasitised about 8% of the pupae of *Carcelia* sp. ? *modicella*.

11. **Leucania loreyi** (Dup.) (Noctuidae)

This is known to feed on paddy in Indonesia and the Philippines (Walker 1961), but it is being recorded as a pest of paddy in India for the first time. In Kerala and Orissa though the pest was observed, no parasites were reared. Parasites were obtained in West Bengal only and these were :

Larval Parasites

HYMENOPTERA

Bethyloidea

BETHYLIDAE

1. **Perisierola** sp.—(new host record) ; Baidyabati, December 1963 and March 1964.

Ichneumonoidea

BRACONIDAE

2. **Rogas** sp.—(new host record) ; Baidyabati and Bandel, January and February 1964.
3. **Charops bicolor**—Baidyabati, March 1964.

Pupal Parasite

Ichneumonoidea

ICHNEUMONIDAE

4. **Barichneumon** sp.—Baidyabati, December 1963 and January 1964.

12. **Mocis frugalis** Fabricius (Noctuidae)

This was scarce and found only at Ernakulam and Alwaye, Yelahanka (Mysore State), and Kalimpong.

No parasites were obtained.

13. **Mocis trifaciata** Scop. (Noctuidae)

This was observed at Kalimpong in small numbers and was the first record of this species on paddy. No parasites were obtained.

14. **Spodoptera mauritia** Boisduval (Noctuidae)

This pest occurred sporadically in several areas. The infestation was severe at Alwaye in November and December 1962 and in October 1963. An outbreak of the pest was observed at Sikkal in February and

March 1964. At Bangalore, Simlagarh (West Bengal), and Bhadreswar stray occurrence of *Spodoptera mauritia acronyctoides* Guénée was noted. In Orissa a severe infestation was noted in 1963 at Sambalpur; *S. m. acronyctoides* was noticed in February 1964 at Birpratappur and Dandamurudapur (Orissa). The following are the parasites recorded:

Larval Parasites

HYMENOPTERA

Ichneumonoidea

BRACONIDAE

1. **Apanteles ruficrus**—Alatambadi (Tamil Nadu). Anantanarayanan & Ayyar (1937) had earlier recorded this parasite on this host.
2. **Meteorus** sp. ? **unicolor** Wesm.—(new host record); Kanjiramittam (Kerala), 1963.

ICHNEUMONIDAE

3. **Charops bicolor**—Kanjiramittam, 1963; Tiruvarur; Sambalpur, 1963, 5% parasitism.

DIPTERA

TACHINIDAE

4. **Drino unisetosa**—Cheuvara, 1963; Baidyabati, 1963.
5. **Pseudoperichaeta orientalis** Wied. (=*anomala* Vill.)—(new host record); Kanjiramittam, 1963.
6. **Strombliomyia aegyptia** Vill.—(new record); Kanjiramittam, 1963.

Pupal Parasites

HYMENOPTERA

Chalcidoidea

CHALCIDAE

7. Unidentified **Haltichellini**—Burnihat, 1962.

Ichneumonoidea

ICHNEUMONIDAE

8. **Netelia** sp.—Bhubaneswar, 1963.

DIPTERA

TACHINIDAE

9. **Actia** sp.—Burnihat, 1962.
10. **Drino** sp.—Burnihat, 1962.
11. **Isomera cinerascens** (Rondani) (=*Gaediogonia jacobsoni* Townsend)—(new record for India); Burnihat, 1962. It is known to attack *S. mauritia* in Malaya (Corbett 1937).

Secondary Parasites

At Gauhati *Syntomosphyrum obscuriceps* Ferrière (Hymenoptera: Eulophidae) was recorded as a secondary parasite of *S. mauritia* through an unidentified Tachinid. *S. obscuriceps* was described from Java where it is a hyperparasite on *Artona catoxantha* Hmps. (Ferrière 1940). Jayaratnam (1941) has recorded it as a hyperparasite of

Nephantis serinopa through the Tachinid *Stomatomyia bezziana* Baranov in Ceylon. This Eulophid is a first record for India.

15. **Plusia chalcites** Esp. (Noctuidae)

This was observed in small numbers at Kalimpong in July 1963. No parasites were obtained.

16. **Pseudaletia separata** Walker (Noctuidae)

This was also rare and found at Chowki, Jorhat and Titabar (Assam), Chandannagar and Kalimpong, and Sambalpur. This has been listed as a pest of paddy in Fiji and the Philippines by Walker (1961). This was hitherto known in India as *Cirphis unipuncta* Haworth, but it has recently been placed under the genus *Pseudaletia* Franclemont ; Ramamani & Subba Rao (1965) who studied the genitalia of specimens identified as *C. unipuncta* report that these are actually *P. separata*.

Cratichneumon sp. (Hymenoptera : Ichneumonidae) (Text-fig. 9) (new record) was reared from the pupae collected at Jorhat.

17. **Cnaphalocrocis medinalis** Guénée (Pyralidae)

The ' paddy leaf-roller ' *C. medinalis* is usually a minor pest. Existing in the field in small numbers it seldom attracts attention, but under certain favourable conditions it multiplies rapidly and occasionally assumes serious proportions. The attack is generally more severe on the younger stages of paddy in the nurseries. At Shillong a fairly severe infestation was noticed from August to September in 1962 ; the infestation in 1963, however, was moderate. In Kerala the attack on the autumn crop during the rainy season was more severe than on the winter crop. On summer crop the pest was noticed only in the early stages when the damage was considerable. Fairly severe infestation was also noticed at Aduthurai and Tiruvarur in December 1961, and from October to December 1963, respectively. At Baidyabati the pest was collected in fairly large numbers on *Sorghum vulgare* from May to June 1964.

Thompson (1944-47) has listed 9 larval and pupal parasites of this pest. During the present survey 32 species of larval and 8 species of pupal parasites were recorded. These are :

Larval Parasites

HYMENOPTERA

Bethyloidea

BETHYLIDAE

1. **Goniozus** sp.—Rudrur (Andhra Pradesh), October 1963 ; Moongilkudi (Tamil Nadu).

2. **Goniozus** sp. nr. **depressus** Kieffer—(Text-fig. 10); Ernakulam, 1963, parasitism negligible; Bhubaneswar; Bandel, Memari (West Bengal).
3. **Goniozus triangulus** Kieffer—(new host record); Tiruvarur, 1963.

Chalcidoidea

ELASMIDAE

4. **Elasmus** sp. a—Shillong, 1962, parasitism negligible; Ernakulam, 1961; Moongilkudi; Bandel and Triveni, 1963, fairly common.
5. **Elasmus** sp. b—(Text-fig. 11) was recorded at Sirpur.
6. **Elasmus** sp. nr. **claripennis** Cameron—Plassey (West Bengal).

EULOPHIDAE

7. **Sympiesis** sp.—(new record); Bandel, 1963.

EURYTOMIDAE

8. **Eurytoma** sp.—Moongilkudi.

PTEROMALIDAE

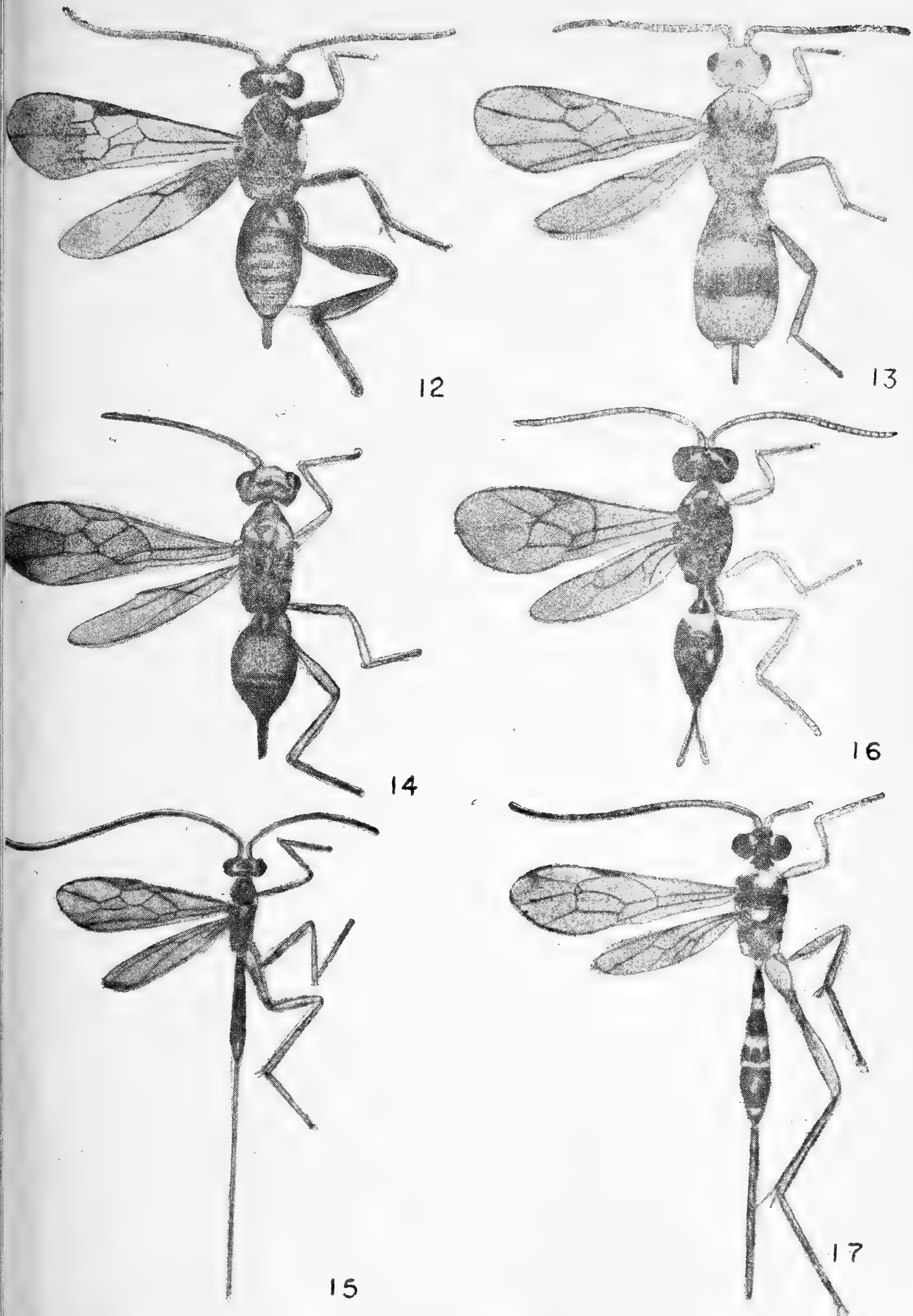
9. **Eupteromalus** sp.—(new host record for India); Tiruvarur, 1963.

Ichneumonoidea

BRACONIDAE

10. **Apanteles** sp.—Ernakulam and Thodupuzha, 1963; Bhubaneswar, 1962.
11. **Apanteles** sp. nr. **opacus** Ashmead—(new record); Bhubaneswar, 1963.
12. **Bracon** sp.—Ernakulam, 1961.
13. **B. gelechiae**—(new host record); Shillong, 1962; Ernakulam, 1963; Baidyabati, 1963.
14. **Bracon ricinicola** Ashmead—Kozhencherri (Kerala).
15. **Cardiochiles** sp.—(Text-fig. 12) Baramunda (Orissa), Sirpur, 1963. Ayyar (1927) recorded *Cardiochiles* sp. on the same host in India.
16. **Cedria anomala** Wilkinson—(Text-fig. 13) (new record); Shillong. Wilkinson (1935) describes it from specimens reared from *Pyrausta mechaeralis* (Walker) (Lepidoptera: Pyraustidae) in Burma.
17. **Hormius** sp.—(Text-fig. 14) (new record); Shillong; Moongilkudi and Tiruvarur, 1963; Memari, 1963.
18. **Macrocentrus** sp. apparently undescribed—(new record); Ernakulam and Kalamassery, 1963.
19. **Macrocentrus** sp.—(Text-fig. 15) (first record for India); Shillong, 1962, 6% parasitism; Tiruvarur, 1963; Chandannagar, 1963.

    A *Macrocentrus* sp. is known to attack *C. medinalis* in Malaya (Corbett & Miller 1933).
20. **Macrocentrus** sp. (group of *linearis* Muesebeck)—(new record); Tiruvarur; Lucknow.
21. **Meteorus bacoorensis** Ashmead—(new record); Kottapuram (Kerala), 1963, parasitism negligible.
22. **Microplitis** sp.—(new record on this host); Baramunda and Sirpur, 1963, parasitism negligible.
23. **Rhysipolis** sp.—Bhubaneswar, 1963.
24. **Spathius** sp.—Shillong, 1962; Bhubaneswar, 1963.



Text-figs. 12. *Cardiochiles* sp. (×7) Ex : *C. medinalis*, Sirpur ; 13. *Cedria anomala* Wilkinson (×19) Ex : *C. medinalis*, Shillong ; 14. *Hormius* sp. (×20) Ex : *C. medinalis*, Memari ; 15. *Macrocentrus* sp. (×5) Ex : *C. medinalis*, Shillong ; 16. *Diatora lissonota* (Viereck) (×12) Ex : *C. medinalis*, Shillong ; 17. *Leptobatopsis annulipes annulipes* Cameron (×5) Ex : *C. medinalis*, Mandya

ICHNEUMONIDAE

25. **Diatora lissonota** (Viereck)—(Text-fig. 16); Shillong, 1962 and 1963. Townes, *et al.* (1961) consider *D. lissonota* as synonym of *Microtoridea lissonota* described by Viereck in 1912 from India and reared from *Achaea janata* Linnaeus. As such *C. medinalis* is a new host record.
26. **Labrorychus apicate** Cameron—Shillong, 1963.
27. **Leptobatopsis annulipes annulipes** Cameron—(Text-fig. 17); Shillong, 1963; Mandya.
28. **Pristomerus** sp.—(new record); Shillong, 1962.
29. **Syzeuctus** sp.—(Text-fig. 18) (new record); Shillong, 1962.
30. **Temelucha** sp. nr. **basimacula** Cameron—(new host record); Bhubaneswar, 1963.
31. Gen. and sp. indet.—(Text-fig. 19); Shillong, 1962, 12% parasitism.

DIPTERA

TACHINIDAE

32. **Chaetomyiobia javana** Brauer & Bergenstamm—(new record for India and on this host); Shillong, 1962.

Pupal Parasites

HYMENOPTERA

Chalcidoidea

CHALCIDIDAE

33. **Brachymeria** sp.—Shillong, 1962; Kalamassery, 1963.
34. **Brachymeria excarinata** Gahan—Shillong, 1962. Gahan (1925) described it from specimens reared from *C. medinalis* in the Philippines.

EULOPHIDAE

35. **Pediobius** sp.—Ernakulam, 1961.
36. **Tetrastichus ayyari** Rohwer—(new host record); Bhubaneswar. Rohwer (1921) described it originally from specimens reared from *Chilo* sp. at Coimbatore (Tamil Nadu).

PTEROMALIDAE

37. **Eupteromalus** sp.—(new host record for India); Tiruvarur, 1963.
38. **Trichomalopsis apanteloctenus**—(new record); Bandel (also recorded as a secondary parasite through *G.* sp. nr. *depressus* in October 1963 at Bandel).

Ichneumonoidea

ICHNEUMONIDAE

39. **Xanthopimpla** sp.—Kalamassery, 1963.
40. **Xanthopimpla immaculata** Morl.—(Text-fig. 20); Ernakulam, 1963; Bhubaneswar, 1963. Thompson (1944-47) lists it as a parasite of *C. medinalis* in India.

Secondary Parasites

At Shillong the pupae of *D. lissonota* were parasitised by *Hypopteromalus* sp., the Ceraphronid *Ceraphron* sp., *Elasmus* sp., *Brachymeria prodeniae* Ashmead, and *Brachymeria* sp.; *B. prodeniae*, *Brachymeria* sp., *Ceraphron* sp., and *Hypopteromalus* sp. were reared from pupae of *Macrocentrus* sp.; the pupae of the unidentified Ichneumonid were parasitised by *Ceraphron* sp., *Hypopteromalus* sp. and *Scenocharops* sp.; *Elasmus* sp., *Elasmus* sp. possibly *zehntneri* Ferrière, *Ceraphron* sp., *Hypopteromalus* sp. and *T. apanteloctenus* parasitised the pupae of *Spathius* sp.; at times *D. lissonota* was obtained from field-collected pupae of *Spathius* sp.; pupae of *Pristomerus* sp. were parasitised by *Ceraphron* sp., *Hypopteromalus* sp. and *Lienella* sp. In Kerala *Eupteromatus parnarae* attacked the pupae of *Bracon* sp.; an unidentified parasite was reared from the pupae of *Macrocentrus* sp., and *Brachymeria* sp. from an unidentified Tachinid. *Eupteromalus* sp. was recorded as a secondary parasite through the pupae of *G.* sp. nr. *depressus* in Orissa. In Lucknow *T. apanteloctenus* was recorded as a secondary parasite through an unidentified Braconid.

18. **Lygropis obrinusalis** Walker (Pyralidae)

This was collected at Bhubaneswar in 1963 in small numbers. Walker (1961) does not list this as a pest on paddy. *Apanteles* sp. was reared from the larvae.

19. **Naranga diffusa** Walker (Pyralidae)

A few caterpillars of this species were collected on paddy at different areas in Kerala in 1963 and at Bhubaneswar and Bandel. This was the first record of the pest on paddy in India. According to Walker (1961) it is a pest of paddy in China, Japan and Malaysia. No parasites were recorded in Kerala. At Bhubaneswar *Elasmus* sp. was reared from the larvae. At Bandel, *Apanteles ruficrus* and *Charops bicolor* were obtained from the larvae. Pupae of *A. ruficrus* were parasitised by *Mesochorus* sp. (Hymenoptera : Ichneumonidae).

20. **Nymphula depunctalis** Guénée (Pyralidae)

A severe attack of the 'case-worm' *N. depunctalis* was observed at Khizhakampalam (Kerala) in August 1962, and at Bhubaneswar in January 1964. At the other localities surveyed the pest was absent, or found in very small numbers only.

The following parasites were reared :

Larval Parasites

HYMENOPTERA

Chalcidoidea

ELASMIDAE

1. **Elasmus** sp.—Ernakulam, 1963.

EULOPHIDAE

2. ? **Diaulomella** sp.—Mandya, August 1962.

Ichneumonoidea

BRACONIDAE

3. **Apanteles** sp.—Ernakulam, 1963.
4. **Bracon** sp.—Ernakulam, 1963; Mandya, 1963.
5. **Hormius** sp. apparently new—(new record) Moongilkudi, 1962 and 1963.

DIPTERA

TACHINIDAE

6. **Halidaya luteicornis**—Ernakulam, 1963 ; Mandya, August 1962.

Pupal Parasites

HYMENOPTERA

Chalcidoidea

EULOPHIDAE

7. **Pediobius** sp.—Ernakulam, 1963.

PTEROMALIDAE

8. **Eupteromalus parnarae**—Ernakulam, 1963.

Ichneumonoidea

ICHNEUMONIDAE

9. **Apsilops** sp.—Bhubaneswar, January 1964.

Secondary Parasites

Brachymeria sp. and *E. parnarae* were reared from pupae of *H. luteicornis* at Ernakulam. At Mandya *Tetrastichus ayyari* was a secondary parasite, possibly through pupae of *H. luteicornis*.

21. **Pyrausta coclesalis** Walker (Pyralidae)

The caterpillars of this species were found feeding on paddy in September and October 1962 in and around Kalimpong. This insect is known to make leaf rolls and feed on the leaves of *Cephalostachyum pergracile* Munro (Beeson 1941), and *Dendrocalamus strictus* Nees (Mathur 1943). But this is the first record of the species as a pest of paddy in India. Malaya is the only other country where it attacks paddy (Walker 1961). The larvae have a reddish tinge in the early instars, the later instars being light yellowish-green. The caterpillars fold together the adjacent leaves of paddy and feed on the leaf tissues. Considerable damage was caused by this pest at Kalimpong in September and October, 1962 and 1963.

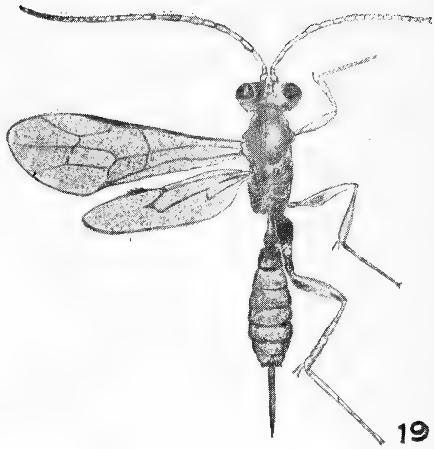
Full-grown caterpillars prepare earthen cells for pupation and hibernation. They hibernate in the soil from November to May.

The pest was found damaging paddy only at Kalimpong, Pedong (West Bengal), and at certain areas in Sikkim, while in Kurseong Subdivision (West Bengal) it thrived on bamboo which is the common host plant.

Apanteles sp. and *Chelonus* sp. (Hymenoptera : Braconidae) were reared from the larvae. *Trichomma* sp. (Hymenoptera : Ichneumonidae) (Text-fig. 21) (new record) was reared from the pupae.

Mathur (1943) has recorded a number of parasites of *P. coclesalis* including *Chelonus* sp.

18



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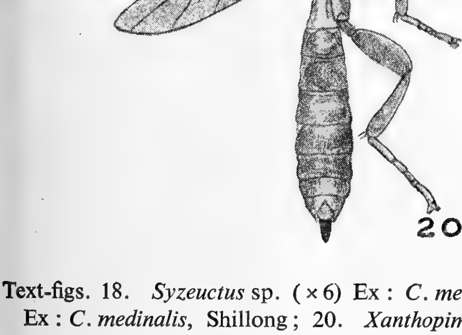

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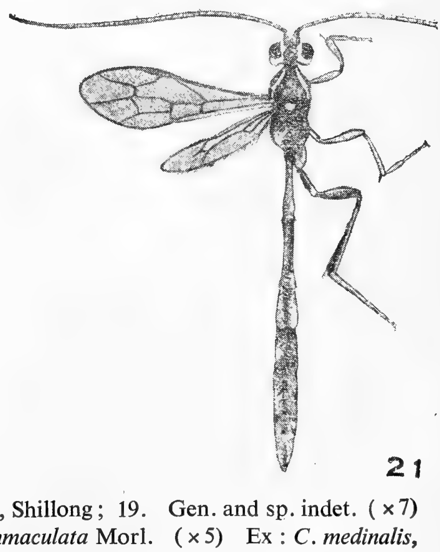

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Text-figs. 18. *Syzeuctus* sp. (×6) Ex : *C. medinalis*, Shillong; 19. Gen. and sp. indet. (×7) Ex : *C. medinalis*, Shillong; 20. *Xanthopimpla immaculata* Morl. (×5) Ex : *C. medinalis*, Ernakulam; 21. *Trichomma* sp. (×4) Ex : *Pyrausta coclesalis*, Kalimpong

22. **Susumia exigua** (Butler) (Pyralidae)

Caterpillars of this species were found forming cases of paddy leaves at Shillong. This is the first record of this insect on paddy in India. It is known to infest paddy in Guam, Japan and Korea (Walker 1961), and in Fiji (Hinckley 1963). No parasites were obtained.

23. **Melanitis ismene** Cramer (Satyridae)

M. ismene was observed in negligible numbers at several of the localities surveyed. The following parasites were reared :

Egg Parasite

HYMENOPTERA

Proctotrupoidea

SCELIONIDAE

1. **Telenomus** sp.—Alwaye, Kampanipadi (Kerala). July 1963 and 1964.

Larval Parasites

HYMENOPTERA

Ichneumonoidea

BRACONIDAE

2. **Apanteles** sp. apparently new—Amausi, September 1963.
3. **Apanteles** sp.—Lucknow, September 1963.

DIPTERA

TACHINIDAE

4. **Exorista larvarum** Linnaeus—(new host record) ; Amausi, September 1963. In India this parasite attacks *Lymantria obfuscata* Walker (Beeson & Chatterjee 1935a).

Pupal Parasites

HYMENOPTERA

Chalcidoidea

CHALCIDIDAE

5. **Brachymeria** sp.—Tiruvarur, October 1963.

EULOPHIDAE

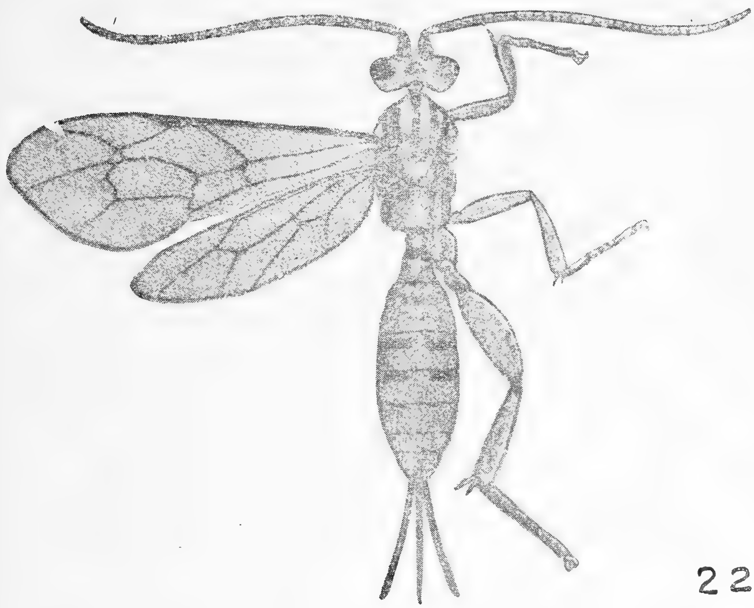
6. **Pediobius** sp.—(new host record ?) ; Burnihat, November 1962 and 1963.

Ichneumonoidea

ICHNEUMONIDAE

7. **Amauromorpha accepta schoenobii** (Vier.)—Mandya, 1963. Rao *et al.* (1968) have recorded it on *Chilotraea auricilia* (Dudgeon) (Lepidoptera : Pyralidae) in India.
8. **Coccygomimus laothöe** Cameron—Mandya, 1963. This has been reared from *Sesamia inferens* (Walker) (Lepidoptera: Noctuidae) in India by Rao *et al.* (1968).

9. **Eccoptosage** sp. ? **schizoaspis** Cushman—(new record on this host) ; Mandya, 1963.
10. **Theronia** sp.—(Text-fig. 22) (new record) ; Mandya, 1963.
11. **Xanthopimpla stemmator** Thunb.—Mandya, 1963.
12. Gen. nr. **Hoplojoppa**—Mandya, 1963.



22

Text-fig. 22. *Theronia* sp. (× 6) Ex : *Melanitis ismene*, Mandya

DIPTERA

TACHINIDAE

13. **Halidaya luteicornis**—Lucknow, September and November 1963.

24. **Mycalesis perseus** Fabricius (Satyridae)

Caterpillars and pupae were collected in small numbers in and around Ernakulam throughout the growing period of the crop in 1963. *Apanteles javensis* was found parasitising the larvae at Kottapuram. This is a new record.

25. **Orsotriaena mandata** Moore (Satyridae)

The caterpillars which are brownish-yellow were found feeding on paddy leaves at Mandya in October 1962. The pupae are also brownish-yellow. This species has been recorded on paddy in Ceylon (Walker 1961) and this is the first record of this pest on paddy in India. Usman and Puttarudraiah (1955) have recorded *O. meda* Fabricius from Chikmagalur (Mysore State).

No parasites were obtained.

26. **Orsotriaena medus** Moore (Satyridae)

A few caterpillars were noticed at Ernakulam and Alwaye in 1963 and *Eurytoma* sp. was reared from them.

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The identification of the eggs of the smaller Indian Cuckoos

BY

C. J. O. Harrison

It is difficult to be certain of the identity of cuckoos' eggs found in nests in regions where more than one species is present. Such eggs tend to be identified from oviduct eggs or by the apparent relative size of the cuckoo species, by the species distribution, or by reference to published information on egg collections. If earlier identifications were at fault errors can be perpetuated in such published information. An examination of collected material on which published information has been based, and in particular that of E. C. S. Baker, revealed that the eggs of *Chrysococcyx maculatus* and *C. xanthorhynchus* appeared to have been confused but were separable into two distinct types, similar host species being used by both. Further field observation is needed to confirm the suggested reidentification. The eggs of *Cacomantis merulinus* appear to have been satisfactorily identified. The identification of eggs of *Surniculus lugubris* and *Cacomantis* (*Penthoceryx*) *sonneratii* is very dubious, and, in the material examined, there would appear to be no certainly identified eggs of these from the Indian region. More field observation is required to clarify the situation. Random collecting is of little value for this, and it would appear to be more profitable to record measurements and appearance of the cuckoo's eggs in the host's nest and to identify the juvenile cuckoo after it has hatched.

The identification of the eggs of cuckoos is one of the least satisfactory aspects of the study of avian parasitism. Once an object such as an egg is separated from the body of the parent bird there must be some element of doubt concerning its origin, and the identification from an egg, of the cuckoo species which laid it, when the egg has been produced at some unspecified earlier date by a bird that may no longer be apparent in the locality where the nest is found, is an exercise heavily weighted with the likelihood of error.

The only *certain* egg of a cuckoo is an oviduct egg, taken from the organs of a dead bird. Since such an egg has not been laid it is possible that it will be incompletely formed, and if the shell lacks its final superficial layers its appearance may differ to some degree from that of the egg that would finally be produced. Blue colour and spotted patterns are usually present throughout the thickness of the shell (Harrison 1966a) and would be visible at any stage, but the final layer producing buff or greenish-coloured eggs would not be present until the egg was fully formed. In assessing the usefulness of the oviduct egg it is also necessary to ensure that the bird itself has been correctly identified.

In addition to oviduct eggs, egg size may aid identification. Within a genus the size of the egg laid may vary according to the body size of the species which produces it. Collectors in the past have recognised this and attributed larger eggs to larger birds. It may, however, result in some anomalies. In both the Indian region and Central Africa there are two species of *Clamator* cuckoos showing some degree of sympatry but differing in size. They lay rather rounded, unmarked, pale blue eggs. The smaller bird, the Pied Crested Cuckoo, *Clamator jacobinus* occurs, and is at present regarded as the same race, *C. j. pica*, in both regions. In Africa a slightly larger bird, Levaillant's Cuckoo, *C. levaillanti*, is also present in some areas ; while in India the smaller bird may be sympatric with the much larger Redwinged Crested Cuckoo, *C. coromandus*.

Although the usually measured dimensions of wing, tail, tarsus, and bill, are similar in *C. jacobinus* in both areas the upper range of egg size is greater in India where the other species is also larger. The picture is confused still further by the fact that the Black-and-White Cuckoo, *C. serratus*, of South Africa is now regarded as a race of *C. jacobinus*, but lays large white eggs, although its measurable dimensions do not differ from those of the latter. There are therefore the possibilities that *C. jacobinus* may vary its egg size in relation to that of the sympatric congeneric species, or that the body size may vary independent of other dimensions and that its variation may be masked by the similarity of the parts normally measured. But in addition it seems possible that in subjectively assigning identifications to eggs, the collectors have made assumptions based on the expected size-range in relation to the other species present and that there is again a possibility of error.

Another aid to the identification of these eggs is the information on species distribution. In some cases only one or two cuckoo species may occur, and in such regions it will be possible to identify and describe eggs accurately, and such information may then be used to separate the eggs in areas where more species are present. This method has been widely used in the case of the many small cuckoo species of the Oriental region but it depends mainly on published information, and unfortunately an early published error can be perpetuated and lead to extensive misidentification of material collected during the subsequent period.

Most of such identification during recent decades has been based on the extensive collections and the publications of E. C. Stuart Baker, notably the volumes on birds of the second edition of the FAUNA OF BRITISH INDIA (Baker 1924-1930) and the NIDIFICATION OF THE BIRDS OF THE INDIAN EMPIRE (Baker 1932-1935). It is therefore to be regretted that a recent examination of the Baker Collection has shown (Harrison 1966b ; Harrison & Parker 1966, 1967a, 1967b) that while the great majority of the eggs are genuine there has also been some misidentification, and there is some evidence of falsification of data, particularly where the eggs of rarer birds are concerned, which makes it necessary to exercise considerable caution in using Baker's published data as a source of reference.

In addition to the faults already mentioned Baker seems to have been uncritical in his acceptance of dubious material. A recent instance has become apparent during the incorporation of the eggs of the Greater Spiderhunter, *Arachnothera magna.* Baker (1932-1935) lists for this species a series of 'unusual types' of eggs. His type 2, two pinkish eggs (B. M. reg. no. 1952.11.79), and type 3, a reddish egg (B. M. reg. no. 1952.11.78), both differ from the eggs of *A. magna* but are indistinguishable in shape, colour, markings, and gloss, from the eggs of the Bulbul, *Pycnonotus atriceps,* of the same localities ; and this can be established by comparison with Baker's own eggs of the latter species. In view of the shape and site of the spiderhunter's nest it is most improbable that the eggs could have been placed there by the bulbul and they must have reached the nest with human aid. It seems remarkable that the similarity of the eggs to those of another species, and their complete dissimilarity to those of the species building the nest, should have escaped Baker's notice ; although his remarks concerning his collectors suggest that he was unduly naive about human nature and the possible outcome of an over-assiduous desire to please.

Another comment should perhaps be added here. Type 1 of Baker's unusual eggs of *A. magna* is pale green with blackish blotches. Baker states in his catalogue that the eggs on which this is based were taken by him and H. N. Coltart in 1903. Another clutch of this type from the same source came to the British Museum via the Davidson collection. There are five eggs in all and they differ from all eggs of *A. magna* in their colour and markings. They closely resemble the eggs of *Passer* species and although it has not been possible to find any exact match among available Indian eggs of this genus, it was found that if put with a selection of eggs of the Spanish Sparrow, *Passer hispaniolensis,* these alleged *A. magna* eggs could not be distinguished apart, and could only be separated again by reference to the setmarks. In the circumstances it seems advisable to defer recognition of such eggs as variant egg of *A. magna* unless further and more satisfactory evidence is available.

In view of such misidentifications it seems advisable to treat Baker's work on the cuckoos with some caution. Undoubtedly both he and Coltart misidentified eggs collected in Assam in the period 1900-1910, but most of these passed into other collections. For example, the British Museum received, with the Davidson collection, eggs identified as *Chrysococcyx xanthorhynchus* by Baker and Coltart, but which are half as large again as eggs of that species and are the broad, pink-spotted eggs subsequently identified by them as those of *Cacomantis* (*Penthoceryx*) *sonneratii.* Some of the inscriptions on eggs in Baker's collection reveal subsequent revision of earlier identification. However, in Baker's final collection on which his NIDIFICATION (1932-1935) was based much of the obviously erroneous material had been eliminated. It has not yet been possible to study all the cuckoos' eggs in detail, but after an overall examination of these eggs it is possible to make some general comments about them and to include some more detailed criticism of some of the material.

There are few immediately apparent anomalies among the eggs of the species of larger cuckoos of the genera *Clamator* and *Cuculus*, apart from a disquieting similarity between eggs identified as those of *Cuculus poliocephalus* and *C. saturatus*, and except for this these may well represent valid material if one allows for the reservations already expressed concerning the separation of similar eggs of different species on size criteria alone.

Chrysococcyx maculatus and C. xanthorhynchus

For the smaller species the situation is less satisfactory. Baker had short series of clutches with hosts' eggs for the Emerald Cuckoo, *Chrysococcyx maculatus*, and the Violet Cuckoo, *Chrysococcyx xanthorhynchus.* He claimed that the eggs of the two could not be distinguished apart, and his identification of the species responsible for any particular egg was based on the bird seen in the locality. A close examination of the series reveals a situation similar to that found in a study of his eggs of the White-tailed Blue Chat and the Large Niltava (Harrison & Parker 1966) where allegedly indistinguishable eggs proved to consist of two mixed series of eggs of quite distinct types. The above two series of cuckoos' eggs showed eggs of two distinct types mixed together. It was possible to separate these. Since *C. maculatus* occurs further west and north in the Himalaya than does *C. xanthorhynchus*, and since some of the eggs from this area were received from A. M. Primrose and C. M. Inglis who had watched nests with similar eggs to determine which cuckoo emerged from the egg, it was possible to assign one type of egg to *C. maculatus* with reasonable confidence. It was also reasonable to assume that the other type was of eggs of *C. xanthorhynchus* since they appeared to fulfil the minimal requirements of habitat and anticipated size.

Of the six apparent eggs of *C. xanthorhynchus* four are of a reasonably standard type. They are broadly ovate but with a distinct taper at one end, and they show a glossy surface, although not so glossy as that of the eggs of the Plaintive Cuckoo, *Cacomantis merulinus.* They vary considerably in colour. One with an egg of the Streaked Fantail Warbler, *Cisticola juncidis*, is white with sparse light brown flecks and a few irregular greyish blotches at the larger end. Another with eggs of the Tailor Bird, *Orthotomus sutorius*, is white with fine dark brown speckling and blotching, and is very heavily marked in a broad zone around, and almost capping, the larger end. An egg with those of the Little Spider-hunter, *Arachnothera longirostris*, is pinkish-white speckled, blotched and streaked with light red, underlying markings showing faintly purple. The last, with eggs of the Grey-headed Flycatcher Warbler, *Seicercus xanthoschistos* is similar to the last but much more heavily freckled and streaked with purplish red. The four eggs measure 16·7 × 12·8, 16·7 × 13·1, 16·7 × 12·7, and 16·6 × 12·5 mm., and their weights range from 83 to 107mg. [I find that Baker's measurements of his eggs are consistently from 0·4 to 0·7 mm. less than more recent measurements of the same specimens.]

In addition to the above there is an egg found with a *Cisticola juncidis* clutch which resembles these other eggs in shape but is slightly rounder and blunter, measuring 16·5 × 13·3 mm. and weighing 78 mg. It is heavily marked with small round blotches, especially towards the larger end, with additional large underlying blotches appearing grey and tending to form a distinct ring around the larger end. Unlike the other eggs the surface lacks the gloss and in this respect it resembles more closely the eggs of *C. maculatus*, but in other respects it appears to resemble an egg of *C. xanthorhynchus*. The sixth egg was found with an egg of the Yellow-backed Sunbird, *Aethopyga siparaja*. It is both small and light, measuring 15·5 × 12·3 mm. and weighing 50 mg. It closely resembles the sunbird egg with which it was found in both colour and markings, and Baker's alternative suggestion that it might be an abnormally large egg of the sunbird cannot be wholly discounted.

There appear to be no oviduct eggs available, and there is no comparative material from elsewhere. A series of five eggs from the collection of Sir W. Williamson, taken from nests of the Ashy Tailor Bird, *Orthotomus sepium* in southern Thailand and attributed to *C. xanthorhynchus* are almost certainly typical eggs of *Cacomantis merulinus* from the smaller end of its size range.

There are twelve apparent eggs of *Chrysococcyx maculatus*, one being from Primrose via the Davidson collection, the others from Baker's collection. The host species are—*Aethopyga siparaja* (6 occasions), *Arachnothera longirostris* (5), and *Cisticola juncidis* (1),—thus showing a complete overlap in host selection with that of *C. xanthorhynchus*. The egg measurements are—average, 16·9 × 12·5; maxima *18·2* × 12·9, 18·1 × *13·5*; minima, *16* × 12·6, 16·3 × *11·9* mm.—and the weight range is 70-100 mg., average 85 mg. In these characters they show no obvious difference to distinguish them from the eggs of *C. xanthorhynchus*, but they differ distinctly from those of the previous species in their appearance. Although the measurements are similar the profiles differ. Eggs of *C. maculatus* are oblong-ovate ; the narrow end being much broader and more rounded than that of *C. xanthorhynchus*. The surface texture is matt and not glossy, and with a slight roughness perceptible to the touch. One egg (B. M. reg. no. 1952.11.80) does, however, have a slight gloss. The colour is generally white with drab brown blotches and specklings, which may be generally distributed or may be limited mainly to a narrow zone around the larger end, giving the pattern a very close resemblance to that of *Arachnothera longirostris*. The only obvious difference is that the markings on the eggs of the latter are chestnut-red and not dull brown, but some of the cuckoo eggs found with clutches of *A. longirostris* do show a warmer brown colour than those found with other hosts. Two clutches (B. M. reg. no. 1952.11.173-4) which Baker thought to be cuckoos' eggs with eggs of *A. longirostris* are considered to be slightly atypical clutches of the latter species, and have been provisionally placed with them. Again there is no comparative material to hand. The egg from Lebong, Sikkim, described by Hume (1890) and later by Oates (1903) as that of *C. maculatus* is in fact a reddish-brown egg of *Cuculus poliocephalus* (B. M. reg. no. 1891.3.20.8154).

Cacomantis merulinus

The eggs of the Plaintive Cuckoo, *Cacomantis merulinus* present no difficulties of identification. The species usually parasitises small warblers such as species of the genera *Orthotomus*, *Prinia*, and *Cisticola*. The eggs are distinctly elongated and slightly oblong-ovate, with a definite gloss. They may be pale blue or white with varying amounts of reddish spots or blotches. They may show some degree of mimicry of the hosts' eggs, as in the case of blue eggs with large red-brown blotches and spots found with similarly-coloured eggs of *Prinia inornata*, and reddish-buff one with the bright chestnut-red eggs of *P. socialis*. Thirty-three eggs from the museum collection, other than those of the Baker collection, measure—average 18·5×13 mm., maxima *20·5×13·8* mm., minima *17·4×11·9* mm. The averages are about 0·5 to 0·7 mm. smaller than those given by Baker.

Surniculus lugubris and **Cacomantis (Penthoceryx) sonneratii**

The identification of the eggs is extremely unsatisfactory for both the Banded Bay Cuckoo, *Cacomantis* (*Penthoceryx*) *sonneratii* and the Drongo Cuckoo, *Surniculus lugubris*. The birds appear from skins to be roughly similar in size, with *C. sonneratii* perhaps a little smaller, but absolute comparison is difficult since *S. lugubris* is a Drongo mimic with long wings and tail.

Baker had two eggs of *S. lugubris* collected by Sody in Java with eggs of the Rusty-vented Bulbul, *Trichastoma sepiaria* (B. M. reg. no. 1952.11.148, 150). The eggs mimic those of the host closely. Dr. J. H. Becking (pers. comm.) who has collected such eggs in Java also observed the cuckoo which hatched from them to confirm identity. Baker (1942) illustrates one clutch but confuses the egg of the host with that of the cuckoo. The eggs are a normal ovate shape but taper less than those of the host and measure 20·9×15·4 and 20·7×15·3 mm.

Other eggs attributed by Baker to this species are less satisfactory. Baker had one egg taken in a nest of Leschenault's Forktail, *Enicurus leschenaulti*, in Malaya and sent to him. He described it (Baker 1932-1935) under *S. l. brachyurus* as having a pale creamy ground colour with a few faint specks of rusty red scattered all over it, and as being a short broad ellipse, measuring 19·5×14·9 mm. If it were a cuckoo's egg it most closely resembled some examples of *Cuculus poliocephalus* to which it might more satisfactorily be attributed. It was very thin-walled and shattered in the hand during examination, and there is a possibility that it might have been an abnormal dwarf egg of the host species. Another specimen with the same host, taken in Assam and listed by Baker (1932-1935) under *S. l. dicruroides* is oblong-ovate with a creamy ground tint and numerous specks and flecks of brown and grey-brown generally distributed but increasing towards the larger end. This measures 22×15·2 mm. (B. M. reg. no. 1952.11.52). It is almost indistinguishable from some eggs attributed to *Cuculus saturatus* and might more reasonably be suspected to belong to that species.

There are two eggs from other sources in Baker's collection attributed by him (Baker 1932-1935) to *S. l. stewarti*. One is with a clutch of *Aegithina tiphia* and was taken by W. E. Wait at Colombo, Ceylon (B. M. reg. no. 1952.11.54). It measures 17·5×13·8 mm. The other is with a clutch of *Rhopocichla atriceps* and was taken by J. Stewart in Travancore (B. M. reg. no. 1952.11.158). It measures 19·4×14·6 mm. Baker (1932-1935) refers to three eggs of the latter type but only one appears in his collection. Both the above eggs are similar to those of the host but much more sparsely marked, mostly at the larger end. Both are distinctly smaller than other eggs attributed to *S. lugubris*. In both measurement and shell-weight they are indistinguishable from typical eggs of the hosts. On the egg with the clutch of *R. atriceps* the markings are sparser than those on the eggs with which it was found but are otherwise similar to those of the host's eggs in size, type, and colour. The markings of the egg found with eggs of *A. tiphia* are small brown and grey spots around the larger end, while those of the host's eggs are elongated brown or grey blotches ; but an examination of a series of eggs of *A. tiphia* reveals that spots may occur in place of blotches and the egg in question, while atypical of the clutch, would not, be atypical of the species.

These eggs were examined through a binocular microscope and it was found that the shells of the two alleged *S. lugubris* eggs differed in their superficial appearance and more closely resembled in surface texture the eggs of the species with which they were found than they resembled each other in this respect. In the circumstances the most economical hypothesis would be to suppose that these two eggs were in fact eggs of the species presumed to be the host in each case ; although this would not explain the appearance of an egg dissimilar in pattern in a clutch of eggs of a species where such a difference does not normally occur.

Of the comparative material available, the Himalayan specimen from the Crowley Bequest listed by Oates (1903) is a small egg, 19·8 × 13·6 mm., rather slender, with a glossy surface, and cream-coloured with light reddish-brown blotches especially around the larger end, (B. M. reg. no. 1901.12.15.474). It appears to be an egg of *Cacomantis merulinus.* The other egg listed by Oates, taken with *Pycnonotus aurigaster* in Java measures 20·5 × 14·5 mm. (B. M. reg. no. 1901.12.15.475). It is pale creamy-buff with a zone of fine reddish marks around the larger end and with some sparse flecks elsewhere. It is rather oblong-ovate in shape, and has little gloss. It is of the type listed by Hoogerwerf (1949) as belonging to *Cacomantis variolosus* ; it is dissimilar to the javanese eggs of *S. lugubris* from the nest of *T. sepiaria* mentioned above, and it has a general resemblance in shape, texture, size, and colour to eggs of *Cuculus poliocephalus.*

There would therefore appear to be no definitely identified eggs of *Surniculus lugubris* from the Indian region, in spite of the fact that the species is said to be widely distributed.

The eggs attributed to *Cacomantis sonneratii* appear to be equally unsatisfactory. Baker (1932-1935) mentions an oviduct egg taken by Kemp, on which he bases his subsequent identifications. This egg was received by the Museum with Davidson's collection (B. M. reg. no. 1925.12.25.5903). It was taken by Kemp at Kalakbund, India, on 1st July 1893, and is stated to be an oviduct egg. It is relatively large, 16·9 × 22·1 mm., and is broadly ovate. It has a glossy surface and has a pinkish ground colour profusely covered with fine purplish-red specks.

Hume (1890) stated that fragment of egg from the oviduct of a shot female were immaculate bluish-green, but subsequently recognised eggs from nests of the Redwhiskered Bulbul, *Pycnonotus jocosus*, as belonging to this species ; two from Coorg, south India, collected on 18 July 1879 (B. M. reg. no. 1891.3.20.8151, 8152) (Oates 1903) being received with his collection. They are both white, one with a few scattered specks, the other evenly marked with fine short dashes and streaks of brown. They measure 21·4 × 16·3 and 20·8 × 15·6 mm. Other browner and more heavily marked eggs from the same host came to the museum with the Davidson Collection.

These eggs are relatively large if one assumes that *C. sonneratii* should lay smaller eggs than those of *S. lugubris*, and in Java, Bartels (1928-1929) was of the opinion that the dissimilar spotted eggs of the same size as those of the hosts, found in the nests of *Aegithina tiphia*, were eggs of *C. sonneratii.* Dr. J. H. Becking (pers. comm.) has suggested that the egg found with a clutch of *A. tiphia* and mentioned above when discussing

S. lugubris may be an egg of *C. sonneratii* ; but for the reasons given I have some doubts about this.

Baker accepted the larger, pink-spotted eggs as typical and amassed a series of 69 eggs with those of the hosts, attributing them to this species. As a series the alleged cuckoo eggs are highly variable, the measurement ranges being—length 18·9-22·3 mm., breadth 14·5-17·2 mm., and the averages being 20·7 and 15·8 respectively. The size range encompasses that of the Javanese eggs of *S. lugubris* and some of the eggs attributed to *C. sonneratii* are indistinguishable from the latter in shape and surface texture. It seems possible that this series might represent a mixture of eggs of both species. An examination of statistical data does not, however, reveal any bimodal distribution that might confirm this. The eggs vary considerably in shape, but these shapes tend to intergrade to an extent where any separation on this character is impossible.

The main host species, with numbers of clutches, are—Nepal Babbler, *Alcippe nipalensis*, (30); Brown Bush Warbler, *Bradypterus luteoventris*, (5); Bulbuls, *Pycnonotus* spp., (4); Tailor Bird, *Orthotomus sutorius*, (3); Spotted Babbler, *Pellorneum ruficeps*, (3); Brown Babbler, *P. albiventre*, (2); and Redheaded Babbler, *Stachyris ruficeps*, (3). In addition there is a long list of host species of only single occurrence.

Several distinct types of colouring and marking are apparent among these cuckoo eggs. Some, usually broadly ovate eggs, are heavily marked with purplish speckling and often have a dark ground colour; many are finely speckled in purplish or pink on a pale or slightly tinted ground colour; and a few are blotched with buff and brown and tend to be more bluntly rounded at the narrow end. These types are not sufficiently distinct to form exclusive entities since some apparently linking forms exist. One fact that does become apparent when colour and markings are considered is that a number of these eggs, while quite distinct from the eggs with which they are placed, are extremely similar to eggs of other passerine species, notably bulbuls, Pycnonotidae ; and in the case of the buff-blotched eggs similar to those of some species of the thrush family, Turdidae. In view of what was said earlier concerning apparent anomalous occurrences of odd eggs of some passerine species in the nests of others, this possibility cannot wholly be dismissed.

We therefore have the various possibilities that these eggs may be those of *C. sonneratii* and that this species lays large and variable eggs ; or that they are a mixture of the eggs of the last species and those of *S. lugubris* ; or that they are the eggs of *S. lugubris* only ; and that some or all might be eggs of passerine species placed, presumably in some cases at least with the aid of human hands, in the nests of different species.

Final Comments

From the preceding account it can be seen that the eggs of some of the smaller Indian cuckoos cannot be identified with any real certainty by use of the collected material at present available. Of the five species discussed, the eggs of *Cacomantis merulinus* can be certainly identified, and it now seems possible to separate the eggs of *Chrysococcyx xanthorhynchus* and *C. maculatus*, although this requires confirmation by further field observation ; but the appearance of Indian eggs of *Cacomantis sonneratii* and *Surniculus lugubris* has still to be established. The further random collection of eggs would not seem likely to clarify this situation. What is needed is a more certain method of linking the cuckoo's egg with the species which laid it.

It is only in the most exceptional circumstances, or after an extremely long and careful period of field observation such as that undertaken by Chance (1922, 1940) for the Eurasian Cuckoo, *Cuculus canorus*, that a cuckoo is likely to be observed in the act of laying its egg. It would therefore seem more profitable to find the cuckoo's egg in the nest of the host, to carefully record the size, shape, and colouring, and then to subsequently observe the nest until the young cuckoo hatches, after which there may be a chance of establishing the identity of it. For this purpose a key to the identification of juvenile cuckoos would be desirable, since such information is often lacking in the normal descriptive handbooks.

In view of the recent advances in maintaining small birds under avicultural conditions it should be possible to keep such small cuckoos and possibly induce them to lay if nests were provided. In such circumstances one could be certain of the species responsible for the production of any eggs that were laid, although some allowance might need to be made for possible atypical eggs resulting from the slightly abnormal conditions.

Under such conditions it might also be possible to rear a fledging cuckoo that could not be satisfactorily identified at an early stage in its development.

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A new Species of *Zornia* Gmel. from S. India

BY

N. Ravi
Sree Narayana College, Punalur

(*With a plate*)

A new species, *Zornia quilonensis*, which comes near *Zornia diphylla* (L.) Pers., is described here. It is based on a study of living specimens collected from Quilon, Kerala, south India.

The plant forming the subject of this paper was first collected by the author from the sandy areas of the Sree Narayana College compound, Quilon, in July 1967. Subsequently it was also collected from several localities in and around Quilon Town. A detailed study of the plant revealed that it is a species of the genus *Zornia* Gmel. which is significantly different from the species so far recorded by Dr. Robert H. Mohlenbrock (1961). A description of the proposed new species, which may be called *Zornia quilonensis*, is given below.

Zornia quilonensis sp. nov.

Herba perennis, caulibus prostratis, ad 50 cm. longis, ramosis, glabris. Folia foliolo duplici constantia ; petioli foliolis longiores, glabri ; foliola oblique oblonga-ovata, mucronata, punctata, uninervia, subpuberula ad basin vel rarius glabra, ad 15 mm. longa, 9 lata ; petioli subpuberuli ; stipulae glabrae, punctatae, 5-7 nerviae, ad 9 mm. longae, 3 mm. latae. Inflorescentia axillaris, spicata, fractiflexa, floribus 3-18 ; bracteae late elliptico-lanceolatae, acutae, ad 10 mm. longae, 4 mm. latae, auricula ad 2.5 mm. longa, 5-nerviae, sparse ciliatae ad margines, facie glabra, punctata ; calyx 3 mm. longus, nervis 4-7 ornatus, nervo anteriore eminente, varie hirsuto, ad margines pilosus ; vexillum 8 mm. longum. Lomentum 2-6-articulatum, exsertum ; articuli $3 \times 2{\cdot}5$ mm., reticulati, punctati, copiose puberulenti, aculeis pluribus 1 mm. longis retrorsum scabris ornati ; semina 2·25 mm. longa, 2 mm. lata, luteolo-brunnea, subreniformia.

Typus lectus ad Quilon in Kerala, in India meridionali, a N. Ravi mense julio 1967 et positus in herbario collegii Sree Narayana ad Quilon sub numero 275.

Zornia quilonensis sp. nov.

Perennial herb. Stem prostrate, 50 cm. long, branched, glabrous. Leaves with two leaflets; petioles longer than the leaflets, glabrous; leaflets obliquely oblong ovate mucronate, punctate, base generally slightly puberulous or rarely glabrous, one nerved, 15 mm. long, 9 mm. broad; petiolule slightly puberulous; stipules glabrous punctate, 5 to 7 nerved, up to 9 mm. long and 3 mm. broad. Inflorescence axillary 3 to 18 flowered zig-zag spike; bracts broadly elliptic-lanceolate, acute, to 10 mm. long, to 4 mm. broad, the auricle 2.5 mm. long, 5 nerved, sparsely ciliate at the margins, surface glabrous punctate; calyx 3 mm. long, 4 to 7 nerved with varying number of stiff hairs on the prominent anterior nerve, hairy at the margins; standard 8 mm. long. Loment with 2-6 articles exerted; articles 3 mm. long, 2·5 mm. broad, reticulate, punctate, copiously puberulent, with numerous retrorsely scabrous prickles to 1 mm. long; seeds 2·25 mm. long, 2 mm. broad, yellowish brown and subreniform.

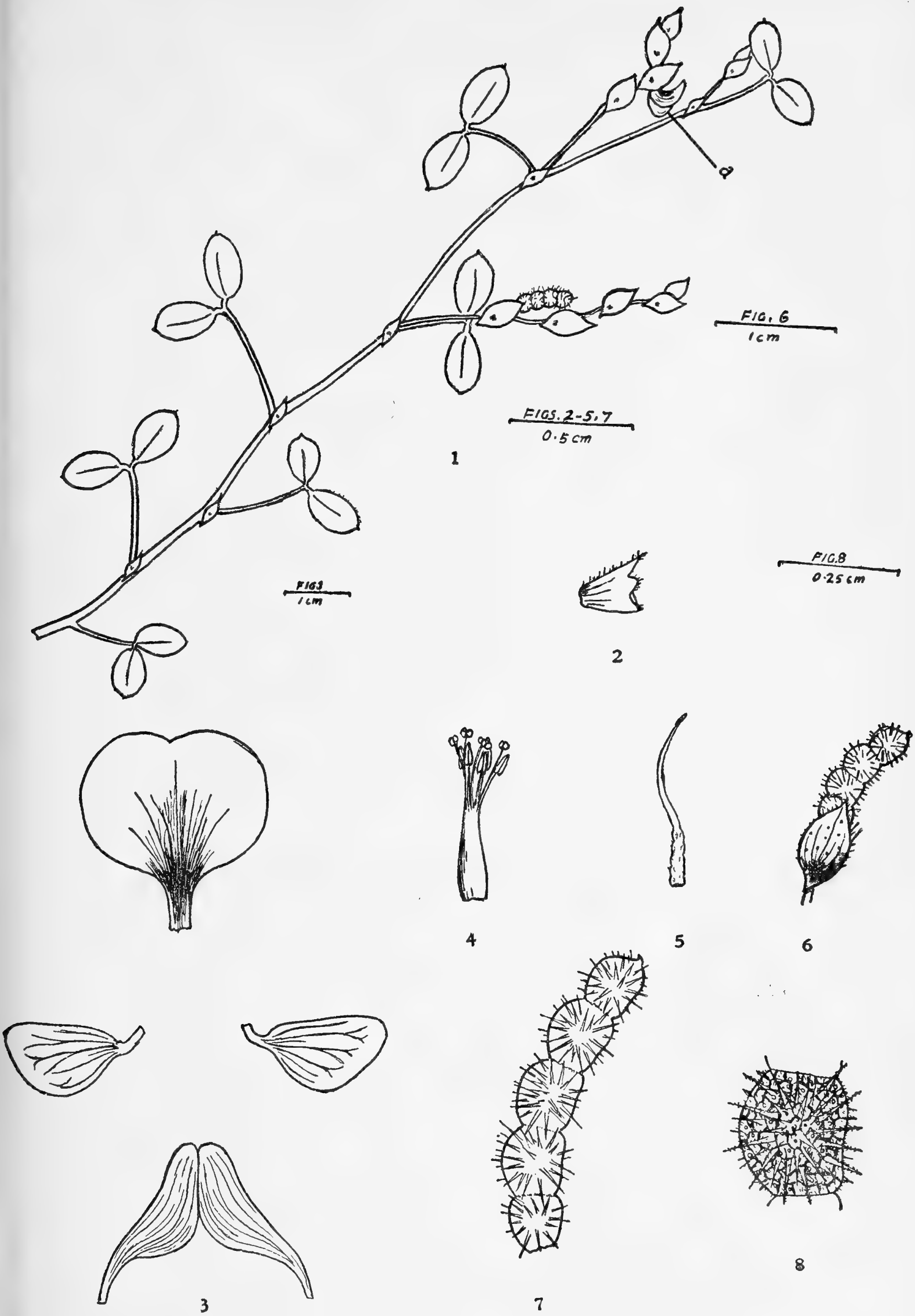
This species appears to be distinct. It certainly can be included in the *Isophylla* group. It resembles *Zornia diphylla* (L.) Pers. in the presence of glandular loments which are much exserted from the bracts. But it differs from the latter in having reticulate loments with scabrous prickles and punctate bracts and leaflets.

Acknowledgements

I am greatly indebted to Prof. N. A. Erady for help all through this work. My sincere thanks are due to Dr. R. H. Mohlenbrock for help in confirming the new species and to Rev. Fr. Dr. H. Santapau for rendering the diagnosis of the new species into Latin.

Reference

Mohlenbrock, R. H. (1961) A monograph on the Leguminous genus *Zornia. Webbia* **16** (1).



Zornia quilonensis sp. nov.

1. A portion of a branch, (*a*) A flower; 2. Calyx; 3. Corolla; 4 . Androecium; 5. Gynoecium; 6. A fruit with bracts; 7. A loment, enlarged; 8. An article of a loment enlarged.

Spider Fauna of India: Catalogue and Bibliography

BY

B. K. Tikader

Zoological Survey of India, Eastern Regional Station, Shillong-4 (Assam), India

[*Continued from Vol.* **66** (1) : 81]

Family Aviculariidae

Genus *ANNANDALIELLA* Hirst 1909

69. **Annandaliella travancorica** Hirst 1909. *Rec. Indian Mus.* **3** : 389.
Distribution : India : Travancore, Western Ghats, Trichur.
Type : BMNH.

Genus *HAPLOCLASTUS* Simon 1892

70. **Haploclastus kayi** Gravely 1915. *Rec. Indian Mus.* **11** : 278.
Distribution : India : Parambikulam, Kerala.
Type : ZSI.

Genus *IDIOPS* Perty 1833

71. **Idiops biharicus** Gravely 1915. *Rec. Indian Mus.* **11** : 261.
Distribution : India : Sahibgunge, Bihar.
Type : ZSI.

Genus *PLESIOPHRICTUS* Pocock 1899

72. **Plesiophrictus bhori** Gravely 1915. *Rec. Indian Mus.* **11** : 277.
Distribution : India : Parambikulam, Western Ghats, Kerala.
Type : ZSI.

73. **Plesiophrictus raja** Gravely 1915. *Rec. Indian Mus.* **11** : 276.
Distribution : India : Kavalai, Kerala
Type : ZSI.

74. **Plesiophrictus satarensis** Gravely 1915. *Rec. Indian Mus.* **11** : 274.

Distribution : India : Satara District, Maharashtra.

Type : ZSI.

Family BARYCHELIDAE

Genus *DIPLOTHELE* Cambridge 1890

75. **Diplothele walshi** Cambridge 1890. *Proc. Zool. Soc. London,* p. 621, fig. 1.

Distribution : India : Bengal, Orissa.

Type : BMNH.

Genus *SASON* Simon 1887

76. **Sason armatoris** Pocock 1900. FAUNA BRIT. INDIA *Arachnida,* p. 174.

Distribution : India : Trivandrum and Ponmudi, Kerala.

Type : BMNH.

77. **Sason andamanicum** Simon 1888. *J. Asia. Soc. Bengal,* **56** : 286, fig. 2.

Distribution : India : Port Blair, Andaman Islands.

Type : MNHN.

78. **Sason cinctipes** Pocock 1892. *Ann. Mag. Nat. Hist.,* **9**(6) : 49, fig. 1.

Distribution : India : Madras ; Ceylon.

Type : BMNH.

Genus *SASONICHUS* Pocock 1900

79. **Sasonichus arthrapophysis** Gravely 1915. *Rec. Indian Mus.* **11** : 264.

Distribution : India : Barkul, Orissa.

Type : ZSI.

80. **Sasonichus sullivani** Pocock 1900. FAUNA BRIT. INDIA *Arachnida,* p. 177.

Distribution : India : Trivandrum, Kerala.

Type : BMNH.

Family Clubionidae

Genus *CHEIRACANTHIUM* Koch 1839

81. **Cheiracanthium saraswatii** Tikader 1962. *J. Linn. Soc. London*, **44** : 568, fig. 1a-d.

Distribution : India : Shillong, Assam.

Type : ZSI.

Genus *PALYSTES* Koch 1875

82. **Palystes flavidus** Simon 1896. *Ann. Soc. Ent. France*, **65** : 489.

Distribution : India : Tiruchirapalli, Calcutta, Allahabad.

Type : MNHN.

Genus *PANDERCETES* Koch 1875

83. **Pandercetes celatus** Pocock 1899. *J. Bombay nat. Hist. Soc.*, **12** : 753.

Distribution : India : Trivandrum, Kerala.

Type : BMNH.

Genus *SELENOPS* Latreille 1819

84. **Selenops montigena** Simon 1889. *J. Asia. Soc. Bengal*, **58** : 335.

Distribution : India : Jaunsar.

Type : MNHN.

85. **Selenops radiatus** Latreille 1819. *Nouv. Dict. d'Hist. Nat.*, **30** : 579.

Distribution : India : Gujarat, Poona, Thana, Uran, Bangalore, Malabar ; Burma ; Madagascar ; Africa.

Type : ?

Genus *SPARIOLENUS* Simon 1881

86. **Spariolenus megalopis** Thorell 1891. *Vet.-Akad. Handl.*, **24** : 77.

Distribution : India : Nicobar Islands.

Type : BMNH.

87. **Spariolenus tigris** Simon 1881. *Act. Soc. Linn. Bord.*, **34** : 281.

Distribution : India : Matheran, Poona, Maharashtra, Calcutta.

Type : MNHN.

Family CRYPTOTHELIDAE

Genus *CRYPTOTHELE* Koch 1872

88. **Cryptothele collina** Pocock 1901. *J. Bombay nat. Hist. Soc.*, **13** : 498.

Distribution : India : Ootacamund, Madras.

Type : BMNH.

Family CTENIZIDAE

Genus *ACANTHODON* Guérin 1838

89. **Acanthodon constructor** Pocock 1900.

Distribution : India : Chingleput, Shevaroy Hills, S. India.

Type : BMNH.

90. **Acanthodon designatus** Cambridge 1885. *Araneidea, Second Yarkand Exp.*, p. 3, fig. 1.

Distribution : India : Murree, Bihar.

Type : BMNH.

91. **Acanthodon fortis** Pocock 1900. FAUNA BRIT. INDIA *Arachnida*, p. 163.

Distribution : India.

Type : BMNH.

92. **Acanthodon fossor** Pocock 1900. FAUNA BRIT. INDIA *Arachnida*, p. 164.

Distribution : India : Deccan.

Type : BMNH.

93. **Acanthodon opifex** Pocock 1899. *J. Bombay nat. Hist. Soc.*, **12** : 750.

Distribution : India : Bombay.

Type : BMNH.

Genus *ACATTYMA* Koch 1877

94. **Acattyma cryptica** Simon 1897. *Mém. Soc. Zool. France*, **10** : 253.

Distribution : India : Dehra Dun.

Type : MNHN.

Genus *HELIGMOMERUS* Simon 1892

95. **Heligmomerus prostans** Simon 1892. *Hist. Nat. Araign. France*, **1** : 91.

Distribution : India : Kodaikanal, Palni Hills.

Type : MNHN.

Genus *NEMESIELLUS* Pocock 1900

96. **Nemesiellus montanus** Pocock 1900. FAUNA BRIT. INDIA *Arachnida*, p. 167.

Distribution : India : Shevaroy Hills, S. India.

Type : BMNH.

Family DICTYNIDAE

Genus *DICTYNA* Sundevall 1833

97. **Dictyna bedeshai** Tikader 1966. *Proc. Linn. Soc. London*, **177** : 50, fig. 4a, b.

Distribution : India : Poona University compound, Maharashtra.

Type : ZSI.

98. **Dictyna chandrai** Tikader 1966. *Proc. Linn. Soc. London*, **177** : 51, fig. 6a, b.

Distribution : India : Karla, Dist. Poona, Maharashtra.

Type : ZSI.

99. **Dictyna rebai** Tikader 1966. *Proc. Linn. Soc. London*, **177** : 45, fig. 1a-c.

Distribution : India : Poona University compound, Maharashtra.

Type : ZSI.

100. **Dictyna shiprai** Tikader 1966. *Proc. Linn. Soc. London*, **177** : 46, fig. 2a-c.

Distribution : India : Poona University compound, Maharashtra.

Type : ZSI.

101. **Dictyna tungabhadrai** Tikader 1966. *Proc. Linn. Soc. London*, **177** : 50, fig. 5a, b.

Distribution : India : Halakote near Mudigere, Dist. Chikmagalur, Mysore.

Type : ZSI.

102. **Dictyna umai** Tikader 1966. *Proc. Linn. Soc. London,* **177** : 48, fig. 3a-c.

Distribution : India : Poona Maharashtra.

Type : ZSI.

Family DIPLURIDAE

Genus *ISCHNOTHELE* Ausserer 1875

103. **Ischnothele dumicola** Pocock 1900. FAUNA BRIT. INDIA *Arachnida*, p. 171, fig. 55.

Distribution : India : Poona, Maharashtra.

Type : BMNH.

Genus *MACROTHELE* Ausserer 1871

104. **Macrothele vidua** Simon 1906. *Ann. Soc. Ent. Paris,* **75** : 279.

Distribution : India : Kalimpong, Kurseong, Darjeeling District.

Type : MNHN.

Family ERESIDAE

Genus *STEGODYPHUS* Simon 1873

105. **Stegodyphus mirandus** Pocock 1899. *J. Bombay nat. Hist. Soc.,* **12** : 750.

Distribution : India : Bombay, Uran, Poona, Punjab and Madhya Pradesh.

Type : BMNH.

106. **Stegodyphus pacificus** Pocock 1900. FAUNA BRIT. INDIA *Arachnida*, p. 209.

Distribution : India : Western India, Eastern Khandesh, Poona, Punjab and Rajasthan.

Type : BMNH.

107. **Stegodyphus sarasinorum** Karsch 1892. *Bert. Ent. Zeits.,* **36** : 275, fig. 4.

Distribution : India : Travancore, Bangalore, Bilaspur, Poona, Calcutta, West Bengal, Rajasthan, Punjab and Barkuda Islands, Orissa.

Type : ?

108. **Stegodyphus socialis** Pocock 1900. FAUNA BRIT. INDIA *Arachnida*, p. 209.

Distribution : India : Bangalore, Rajasthan, Maharashtra.

Type : BMNH.

109. **Stegodyphus tibialis** (Cambridge 1869). *Eresus tibialis* Cambridge 1869. *Ann. Mag. Nat. Hist.*, **3** : 71, figs. 70, 71.

Distribution : India : South India, Mysore ; Burma.

Type : BMNH.

Family FILISTATIDAE

Genus *FILISTATA* Latreille 1810

110. **Filistata poonaensis** Tikader 1963. *J. Poona Univ. Sci. & Tech.* **24** : 35, fig. 3.

Distribution : India : Poona, Maharashtra.

Type : ZSI.

Family GNAPHOSIDAE

Genus *GNAPHOSA* Latreille 1804

111. **Gnaphosa kailana** Tikader 1966. *Rec. Indian Mus.*, **59** : 438, fig. 1a-d.

Distribution : India : Jodhpur, Rajasthan.

Type : ZSI.

Genus *DRASSODES* Westring 1851

112. **Drassodes malodes** Tikader 1962. *Proc. Indian Cong. Zool.* **2** : 572, fig. 2a-c.

Distribution : India : Dhakuria, Calcutta.

Type : ZSI.

113. **Drassodes phygduaensis** Tikader 1964. *Rec. Indian Mus.* **59** : 261, fig. 3a-d.

Distribution : India : Phagdua, Central Himalaya.

Type : ZSI.

Genus *PHAEOCEDUS* Simon 1893

114. **Phaeocedus mosambaensis** Tikader 1964. *Rec. Indian Mus.* **59** : 262, fig. 4a-d.

Distribution : India : Near Mosamba Lake, Central Himalayas.

Type : ZSI.

Genus *SCOTOPHAEUS* Simon 1893

115. **Scotophaeus domesticus** Tikader 1962. *Proc. Indian Cong. Zool.* **2** : 570, fig. 1a-c.

Distribution : India : Dhakuria, Calcutta.

Type : ZSI.

116. **Scotophaeus rajasthanus** Tikader 1966. *Rec. Indian Mus.* **59** : 440, fig. 2a-c.

Distribution : India : Merta, Dist. Nagpur, Rajasthan.

Type : ZSI.

Family HAHNIIDAE

Genus *HAHNIA* Koch 1841

117. **Hahnia alini** Tikader 1964. *Rec. Indian Mus.* **59** : 259, fig. 2a-c.

Distribution : India : Lunak, Central Himalayas.

Type : ZSI.

Family HERSILIIDAE

Genus *HERSILIA* Audouin 1826

118. **Hersilia kalimpongensis** Sinha 1950. *Rec. Indian Mus.* **48** : 124.

Distribution : India : Kalimpong, Dist. Darjeeling, E. Himalayas.

Type : ZSI.

119. **Hersilia pectinata** Thorell 1895. SPIDERS OF BURMA, p. 58.

Distribution : India : Mysore, Coorg ; Burma ; Ceylon and Malay Peninsula.

Type : BMNH.

120. **Hersilia savignyi** Lucas 1836. *Mag. Zool. Ganne classe*, **8** : 10, fig. 1.

Distribution : India : Mysore, Maharashtra, Kerala, Gujarat, West Bengal ; Burma and Ceylon.

Type : ?

121. **Hersilia stevensi** Sinha 1950. *Rec. Indian Mus.* **48** : 123, fig. 1.

Distribution : India : Gopaldhara, Darjeeling.

Type : ZSI.

Genus *MURRICIA* Simon 1882

122. **Murricia indica** Lucas 1836. *Mag. Zool. Ganne classe*, **8** : 7, fig. 2.

Distribution : India : Bombay and Malabar.

Type : ?

Genus *TAMA* Simon 1882

123. **Tama gravelyi** Sinha 1950. *Rec. Indian Mus.* **48** : 126, fig. 3c.

Distribution : India : Kavalai, Kerala.

Type : ZSI.

(*to be continued*)

Toxic chemicals and baits for the control of two Gerbils, *Meriones hurrianae* Jerdon and *Tatera indica* Hardwicke

BY

ISHWAR PRAKASH,[1] W. D. FITZWATER,[2] AND A. P. JAIN[3]

Bait preference trials on the desert gerbil (*Meriones hurrianae*) and the Indian gerbil (*Tatera indica*) showed that bajri, jowar, mukka and chana grains and flours may be used as baits for their control. The addition of 5 to 10 per cent groundnut, sesame or coconut oil may increase the attractiveness of the bait.

Lethal dosages of zinc phosphide, sodium monofluoroacetate, Gophacide, strychnine alkaloid and thallium sulphate were determined by administering these toxic chemicals by stomach tubes. Norbormide (Raticate) was found to be ineffective on both species of gerbils even at a 1000 mg./kg. dosage. The suitability of these poisons for the control of gerbils in the field is discussed.

INTRODUCTION

The two species of gerbils, *Meriones hurrianae* Jerdon and *Tatera indica* Hardwicke, found in the Rajasthan desert prefer the same species of grasses that constitute the main feed of livestock. In laboratory trials the order of their preference was *Lasiurus sindicus, Cenchrus ciliaris, Cenchrus setigerus* and *Panicum antidotale*. *Tatera*, however, preferred *C. setigerus* to *C. ciliaris.* These gerbils, particularly *M. hurrianae,* which is abundant in this desert (Prakash 1962), are competitors to livestock as far as fodder is concerned and unless a proper control programme is initiated, the development of ranges to yield substantial amounts of fodder may not prove successful. In recent years attempts (Ganguli & Kaul 1962; Prakash & Kumbkarni 1962; and Prakash 1964) were made to find suitable baits and adequate poison for the control of desert gerbils. Wheat flour and zinc phosphide were recommended. This paper deals with further trials of baits and attractants and compares the lethal efficiency of various toxic chemicals for both species of gerbils.

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[1] *Animal Ecologist, CAZRI, Jodhpur, Rajasthan.*
[2] *UNESCO Consultant, CAZRI, Jodhpur, Rajasthan.*
[3] *Senior Scientific Assistant. CAZRI, Jodhpur, Rajasthan.*

Methods

We had considerable difficulty in overcoming wastage of candidate bait materials, particularly the flours, as gerbils would dig the materials out and often sleep in the bait dishes. Thus much of our earlier work had to be discarded until we devised small, covered bait dishes, which with a training period to accustom the gerbils to accept the day's ration in a two-hour period, eliminated most of this problem. Three baits from a series of ten candidate baits were selected with the aid of random number tables and exposed to ten individually-caged gerbils for a five-day period. This was based on a similar experimental design worked out for *Rattus norvegicus* with the aid of Purdue University (West Lafayette, Indiana, U.S.A.) statisticians. The consumption was measured daily for each bait and replaced with a new series of baits the following day. Toxic chemicals were dissolved in water or suspended in oil or gum arabic solution. These were administered to individual gerbils by stomach tube. The dosages were calculated for individual gerbils according to body weight. For most of the dosages listed on Tables 2 and 3, ten gerbils of approximately the same weight class were used in each series.

Observations and Discussion

Baits and Additives

The daily total consumption of each bait offered during the acceptance tests was averaged at the end of the week (ADI=Average Daily Intake). That bait's percentage of the total consumption (Per cent) and its acceptability position (Rank) were then computed for each particular series. These data are presented below :

Meriones hurrianae

Test	*Bait material and additives*	*ADI*	*Per cent*	*Rank*
A	Bajri	2·20	24·4	1
	Bajri + 5% groundnut oil	1·90	21·1	2
	Chana	0·56	6·2	8
	Chana, cracked	0.99	11·0	3
	Barley	0·95	10·6	4
	Jowar	0·67	7·4	7
	Jowar + 5% groundnut oil	0·75	8·3	5
	Mukka	0·70	7·8	6
	Guar	0·17	1·9	9
	Guar + 5% groundnut oil	0·07	0·1	10
B	Bajri flour + 10% groundnut oil	1·59	20·3	1
	Bajri + 3% groundnut oil + 1% salt	1·30	16·6	2

Test	Bait material and additives	ADI	Per cent	Rank
	Chana flour	0·60	7·6	6
	Chana flour + 10% groundnut oil	1·08	13·8	3
	Jowar flour	0·57	7·3	7
	Jowar flour + 10% groundnut oil	0·78	10·0	5
	Jowar + 3% groundnut oil + 1% salt	0·80	10·2	4
	Bajri flour	0·52	6·6	8
	Guar flour	0·17	2·1	10
	Guar flour + 10% groundnut oil	0·36	4·6	9
C	Bajri	1·62	22·8	1
	Bajri + 5% groundnut oil	0·95	13·3	2
	Bajri + 3% groundnut oil + 1% salt	0·85	12·0	3
	Bajri flour + 10% groundnut oil	0·70	9·8	5
	Jowar flour + 10% groundnut oil	0·41	5·7	8
	Jowar + 5% groundnut oil	0·45	6·3	7
	Jowar + 3% groundnut oil + 1% salt	0·36	5·1	9
	Chana	0·30	4·2	10
	Chana flour + 10% groundnut oil	0·79	11·1	4
	Barley	0·64	9·0	6
D	Bajri + 3% groundnut oil	1·80	25·3	1
	Bajri + 3% sesame oil	1·52	21·4	2
	Bajri + 3% coconut oil	1·05	14·7	3
	Bajri + 3% mustard oil	0·96	13·5	4
	Jowar + 3% coconut oil	0·62	8·7	5
	Jowar + 3% mustard oil	0·26	3·6	7
	Chana + 3% coconut oil	0·28	3·9	6
	Chana + 3% sesame oil	0·24	3·3	8
	Chana + 3% groundnut oil	0·22	3·0	9
	Chana + 3% mustard oil	0·12	1·6	10

Tatera indica

Test	Bait material and additives	ADI	Per cent	Rank
A	Bajri	1·35	21·1	2
	Bajri + 5% groundnut oil	1·54	24·1	1
	Bajri flour + 10% groundnut oil	0·54	8·4	6
	Jowar	0·46	7·2	7
	Jowar + 5% groundnut oil	0·77	12·0	3
	Mukka	0·64	10·0	4
	Barley	0·58	9·1	5
	Chana	0·19	3·0	9
	Chana + 5% groundnut oil	0·29	4·5	8
	Guar	0·03	0·4	10
B	Bajri	0·99	19·8	2
	Bajri + 5% sesame oil	1·17	23·4	1
	Jowar	0·46	9·2	4
	Jowar + 5% sesame oil	0·72	14·4	3
	Mukka	0·13	2·6	10
	Mukka + 5% groundnut oil	0·39	7·8	5
	Mukka + 5% sesame oil	0·36	7·2	6
	Chana	0·34	7·0	7

Test	Bait materials and additives	ADI	Per cent	Rank
	Chana + 5% sesame oil	0·25	5·0	8
	Wheat	0·23	4·6	9
C	Bajri + 5% groundnut oil	2·45	20·8	1
	Bajri + 5% sesame oil	1·73	14·7	2
	Mukka + 5% groundnut oil	1·57	13·3	3
	Jowar + 5% groundnut oil	1·45	12·3	4
	Jowar + 5% sesame oil	1·28	10·8	5
	Chana + 5% groundnut oil	0·59	5·0	8
	Chana + 5% sesame oil	0·90	7·6	6
	Wheat + 3% groundnut oil	0·79	6·7	7
	Wheat + 3% sesame oil	0·66	0·6	10
	Barley + 3% groundnut oil	0·37	3·1	9
D	Bajri + 3% sesame oil	1·54	19·7	1
	Bajri + 3% mustard oil	1·20	15·4	2
	Bajri + 3% coconut oil	1·12	14·3	3
	Bajri + 3% groundnut oil	1·08	13·8	4
	Chana + 3% groundnut oil	0·76	9·7	5
	Chana + 3% coconut oil	0·70	8·9	6
	Chana + 3% sesame oil	0·54	6·9	7
	Chana + 3% mustard oil	0·43	5·5	8
	Jowar + 3% coconut oil	0·30	3·8	9
	Jowar + 3% mustard oil	0·14	1·7	10
E	Bajri + 3% groundnut oil + 1% salt	1·75	31·2	1
	Bajri + 3% groundnut oil + 1% sugar	1·75	31·2	1
	Chana + 3% groundnut oil + 1% salt	0·58	10·3	3
	Jowar + 3% groundnut oil + 1% salt	0·54	9·6	4
	Wheat + 3% sesame oil	0·54	9·6	4
	Wheat + 3% groundnut oil	0·13	2·3	6
	Barley + 3% groundnut oil	0·11	1·9	7
	Barley + 3% sesame oil	0·07	1·2	9
	Guar + 5% groundnut oil	0·06	1·0	10
F	Bajri + 3% groundnut oil + 1% sugar	1·83	23·7	1
	Bajri + 3% groundnut oil + 1% salt	1·77	22·9	2
	Bajri + 3% sesame oil	1·19	15·4	3
	Bajri + 3% groundnut oil	1·17	15·1	4
	Jowar + 3% sesame oil	0·47	6·1	5
	Jowar + 3% groundnut oil	0·29	3·7	6
	Jowar + 3% groundnut oil + 1% sugar	0·23	2·9	9
	Chana + 1% sesame oil + 1% sugar	0·26	3·3	8
	Chana + 3% sesame oil + 1% sugar	0·17	2·2	10
	Chana + 3% groundnut oil + 1% sugar	0·29	3·7	6

In the *Meriones* trials, Test A was for different grains along with the effect of oil. Bajri (*Pennisetum typhoideum*) showed distinct superiority over all the others while guar (*Cyamopsis tetragonoloba*) was decidedly inferior. Barley (*Hordeum vulgare*) and cracked chana (*Cicer arietinum*) were slightly better than the rest though not significantly so. The addi-

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tion of oil had no apparent effect on palatability. Cracked chana was definitely superior to whole chana and thus this form was used throughout the rest of the test, though it is entered as only ' chana '. Test B was on the flours of the different grains. While bajri was again high, the difference was not so noticeable. In this test the addition of oil definitely increased the acceptance of all the flours. Whether this effect was due to attractiveness of the oil alone or in part changing the physical character of the bait by clumping it in particle form was not determined. Test C checked the flours against the whole grains. In this one, bajri again was superior and this was particularly noticeable in the whole grains over the flour. The whole grain was better in the case of jowar (*Sorghum vulgare*) but the situation was reversed with chana. Salt appeared to have a slight deterrent effect. In the final test, D, we were primarily interested in comparison of different oils. This substantiated the conclusion in Test A that while the oils generally enhanced a particular grain, they rarely raised it to a position higher than the palatability of the grain itself. Thus grain baits in order of preference were bajri, jowar and chana. There was no significant difference between the four oils used : groundnut (*Arachis hypogea*), sesame (*Sesamum indicum*), coconut (*Cocos nucifera*) and mustard (*Brassica campestris*), though there was definite indication that mustard was the least acceptable of the group. Thus it appears that the oils can be used interchangeably, depending upon their availability and cost.

The *Tatera* tests were run after we had overcome some of the technical difficulties in the previous *Meriones* trials. Test A for various grains showed bajri again definitely superior followed by jowar, mukka (*Zea mays*), barley, chana and the definitely inferior guar. Here the addition of groundnut oil showed a slightly increased degree of palatability. The only flour entrant, bajri, fell definitely below its group. Test B was somewhat similar and gave about the same results : bajri, jowar, mukka, chana, and wheat (*Triticum aestivum*). In mukka the addition of oil very definitely increased the palatability of that grain. The next test, C, was a comparison of grains with groundnut and sesame oils. Here bajri, mukka, jowar, chana, wheat and barley appeared in that order. With the exception of chana, groundnut appeared to be slightly better than sesame for any grain. Test D was a further check of the different oils. As in the case of *Meriones* the oils did not change the rank between various grains, with the exception of chana which forged ahead of jowar. The order of the oils varied with different grains and it was not a clear-cut indication of preferences as in the previous *Meriones* test. Test E showed bajri, chana, jowar, wheat, barley and guar. Salt and sugar additives had apparent equal effect on bajri. In the final test, F, jowar and chana changed places again and the results with sugar and salt were not conclusive. In summation, bajri was definitely the most superior

TABLE 1

AVERAGE CONSUMPTION (GRAMMES) OF BAIT BY *M. hurrianae* IN 2 HOURS AFTER OVERNIGHT STARVATION

Bait	Grains Only	Grains + 5% Sesame Oil	Grains + 5% Groundnut Oil	Flour only	Flour + 5% Sesame Oil	Flour + 5% Groundnut Oil
Guar ..	0·0	0·20 ± 0·04	0·15 ± 0·05	0·21 ± 0·09	0·23 ± 0·15	0·80 ± 0·31
Jowar ..	0·92 ± 0·16	0·68 ± 0·14	0·97 ± 0·12	1·4 ± 0·21	1·57 ± 0·27	1·75 ± 0·25
Bajri ..	0·77 ± 0·05	1·35 ± 0·19	1·53 ± 0·11	1·33 ± 0·18	1·61 ± 0·21	1·76 ± 0·29
Mukka ..	0·65 ± 0·19	0·30 ± 0·11	0·68 ± 0·23			
Chana ..	0·56 ± 0·22	0·47 ± 0·18	0·47 ± 0·25	2·3 ± 0·28	1·3 ± 0·18	1·1 ± 0·23
Chana (cracked)	0·86 ± 0·25	0·71 ± 0·24	0·51 ± 0·15			

of the grain baits. There was little difference among chana, jowar and mukka and the fact that these larger grains are better adapted to holding a lethal dose per particle, makes them more promising bait materials

TABLE 2

LETHAL DOSAGES OF VARIOUS TOXIC CHEMICALS, HOURS TO DEATH AND PER CENT OF KILL FOR *M. hurrianae*

Toxic chemical	Dose admin. (mg./kg.)	Hours to death	Per cent killed
Zinc phosphide	50	1·95 — ON*	82
	40	1·87 — ON*	65
	35	2·00 — ON*	50
	30	2·70 — ON*	30
	20	5·42 — 44.	25
	10	none killed	0
Sodium monofluoroacetate ..	10	0·77 — ON*	100
	5	0·10 — ON*	100
	1	0·50 — ON*	70
	0.7	2·23 — ON*	70
	0.6	2·07 — 2·63	50
	0.5	1·17 — ON*	40
Gophacide ..	7	0·33 — 72	100
	5	ON* — 48	80
	4	27·17 — 144	20
	3	26·88 — 72	20
	1	none killed	0
Strychnine alkaloid	7	0·25 — 0·40	100
	5	0·03 — 2·00	50
	2	0·42 — 1·50	40
	less than 2	0·22 — 0·50	21
Thallium sulphate	35	72 — 144	80
	30	48 — 192	90
	25	24 — 168	70
	20	96 — 240	50
	15	96	11
Norbormide	1000	none killed	0

*ON—Test animal died overnight

than bajri. Wheat and barley can be used but guar is definitely unacceptable in any form. The whole grains showed a definite superiority over the flours. The addition of oil to the flours improved their general acceptance. There is apparently no significant difference among the oils though it is felt that mustard might be the poorest. The addition of 1 per cent salt or sugar exerted little or no effect on acceptance.

Toxic chemicals

Zinc Phosphide : Samples of this toxicant sold by Bharat Pulverising Mills Private Ltd. (India) and Gallard-Schlesinger Chemicides (U.S.A.) were tested separately to compare their efficiency. Since no significant

TABLE 3

LETHAL DOSAGES OF VARIOUS TOXIC CHEMICALS, HOURS TO DEATH AND PER CENT OF KILL FOR *T. indica*

Toxic chemical	Dose admin. (mg./kg.)	Hours to death	Per cent killed
Zinc phosphide	50	5·33 – 10·13	80
	40	3·60 – ON*	80
	35	5·17 – 8·00	60
	30	3·15 – ON*	40
Sodium monofluoroacetate	1.5	1·83 – 48	60
	1.3	1·70 – 8·03	60
	1.0	1·17 – 2·63	50
	0.9	2·45 – 7·92	50
	0.8	2·15 – 3·50	20
	0.7	– 1·58	10
Gophacide	40	2·73 – 5·42	100
	20	3·20 – 4·95	100
	15	3·43 – 6·52	100
	10	3.75 – 8·00	100
	5	5·58 – 21·15	90
	3	2·95 – ON*	30
	1	3·53 – 72	30
Strychnine alkaloid	10	0·15 – 1·02	100
	5	0·25 – 2·20	60
	2	0·15 – 0·47	40
	less than 2	none killed	0
Thallium sulphate	35	120–168	86
	30	168	100
	25	144–168	30
	20	168	30
	15	none killed	0

*ON—Test animal died overnight

difference was found, the results were combined in the following tables. LD_{50} for the desert gerbil was found to be 35 mg./kg. while this dosage gave an LD_{6} for the Indian gerbil. Poison baiting with 1·5 to 2 per cent zinc phosphide mixed in wheat flour has killed 84-90 per cent of desert gerbils in the field.

Sodium Monofluoroacetate : This chemical is popularly known as Compound 1080. It is a very toxic chemical as the LD_{50} for the desert gerbil and the Indian gerbil was 0·6 mg./kg. and 0·9 mg./kg. respectively.

In a field test using Compound 1080 at 0·02 per cent soaked on bajri grain, we achieved a 100 per cent reduction on a colony of desert gerbils. In Australia, 0·01 per cent Compound 1080 mixed with carrots and 0·038 per cent on oats is used for poisoning rabbits (*Oryctolagus cuniculus*) (Anon. 1961).

Gophacide : This is a new chemical (0, 0 bis alpha-chlorophenyl acetimidoyl phosphoramidothioate) which is also called by code numbers Bayer 38819 and DRC-714. A dosage of 5 mg./kg. was found to have an LD_{80} for desert gerbils and an LD_{90} for Indian gerbils. It is a quick-acting toxicant and has been found very acceptable for pocket gophers in the United States on grain baits at 0·1 to 0·2 per cent (Ward *et al.* 1967).

Strychnine Alkaloid : This poison is extracted from the seeds of *Strychnos nux vomica* plants. In India this form is not used as widely as the hydrochloride salt. The LD_{50} for desert gerbils was found to be 5 mg./kg. and LD_{60} for Indian gerbils at the same dosage. It is very quick-acting as death in the desert gerbil occurred within 2 to 20 minutes and within 9 to 120 minutes in the Indian gerbil.

Thallium Sulphate : This is a slow-acting poison sometimes taking up to ten days before death. The LD_{50} of this poison was 20 mg./kg. for the desert gerbil whereas the same dosage gave an LD_{30} for the Indian gerbil.

Norbormide (Shoxin or Raticate) : This is a very specific poison for the brown rat (*Rattus norvegicus*) in the United States. Deoras (1965) found it to be very effective against that species but was able to kill only 60 per cent of *Rattus rattus* with a 0·5 per cent bait. In other studies (Kapoor *et al.* 1965), it was found to be ineffective for *Mus musculus* and *Bandicota bengalensis*. We found it apparently ineffective against both species of gerbils as no deaths were obtained with dosages as high as 1000 mg./kg.

Zinc phosphide being commonly used as a rodenticide in India should be extensively used for gerbil control. Its black colour and pungent odour serve as a warning to reduce the hazards to humans. While universally used as a rodenticide for commensal rodents, Compound 1080 is very dangerous. However, it may find application at low dosages for the field control of the gerbils. The rabbit control programme in Australia is based on the usage of this compound (Anon. 1961). In the intestine it is rapidly absorbed through the unbroken mucous membrane. It has a strong effect on either or both cardiovascular and nervous systems. The contractile power of the heart is lost thereby reducing the blood pressure. It is tasteless and readily soluble in water, so it can be easily mixed with any bait material. But these good qualities as a rodenticide make it dangerous to humans, and, therefore, it should not be given to untrained persons for handling. Gophacide, while not commonly available, may prove to be an excellent field rodenticide. Thallium sulphate is an effective rodenticide but due to its hazardous properties is no longer permitted in the United States. Strychnine alkaloid while a good field rodenticide has a bitter taste and its quick effects on the system lowers its potential utility in gerbil control. Norbormide appears to be ineffective against either gerbil.

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Three new grasses from the former Bombay Presidency

BY

M. R. ALMEIDA

Blatter Herbarium, St. Xavier's College, Bombay-1

(*With three text-figures*)

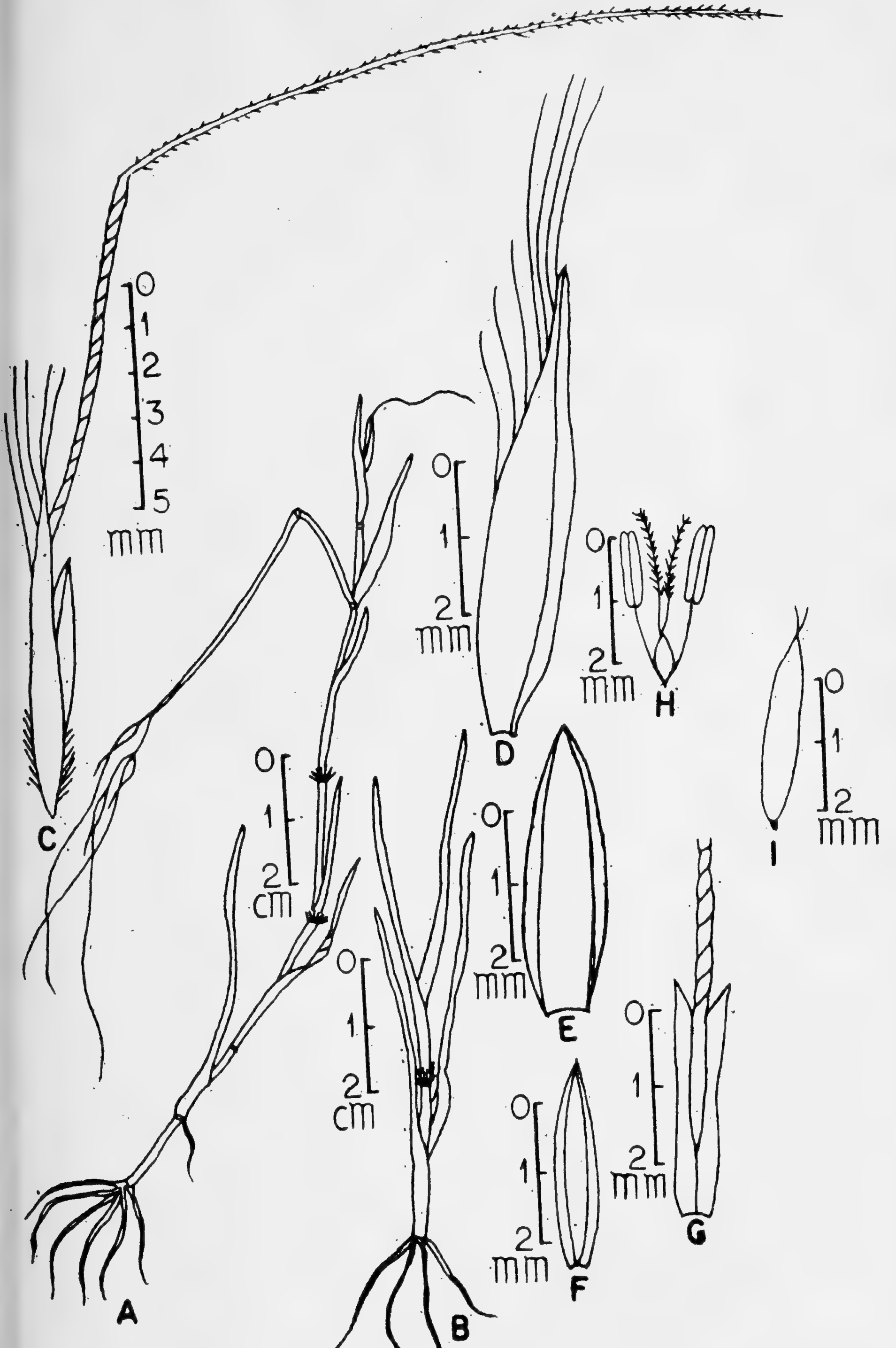
Working through the grasses in Blatter Herbarium, I came across a few interesting specimens, which I separated for detailed study, and which are here presented as three new taxa. The new species, *Arthraxon satarensis*, was unidentified in Blatter Herbarium ; the species here described as *Dimeria santapaui* had been identified, wrongly, as *D. woodrowii* ; *Ischaemum borii* had been identified as *I. diplopogon*. My identifications have been checked by Dr. N. L. Bor of Kew and confirmed as correct.

I take pleasure in dedicating *Dimeria santapaui* to Rev. Fr. Dr. H. Santapau, ex-Director, Botanical Survey of India, for his dedicated services to Indian botany. I am also very happy to dedicate *Ischaemum borii* to Dr. N. L. Bor, for his contributions to botany and in particular for his monumental work on Asiatic grasses. The third taxon *Arthraxon satarensis* commemorates the place from where the specimen was collected.

Dimeria santapaui sp. nov.

Ab omnibus speciebus generis *Dimeriae* hucusque notis praesens species differt recemo solitario.

Gramen annuum, ad 15 cm. altum, e basi erectum, teres, glabrum, pilis longis tenuibus ornatum sub ipsos nodos, ipsosque nodos operientibus. *Folia* inferiora lineari-acuminata, erecta, ad 5 cm. longa, 2 mm. lata, glabra et penitus scabra ; folia superiora ca 3·5 cm. longa, inferioribus latiora, glabra et subacuta ; vagina arctissima, dimidium internodii amplectens, non carinata, subhyalina ad margines. *Inflorescentia* solitaria racemosa constans spiculis 2-7, terminalis insidens pedunculo longe exserto ; racemi ad 2 cm. longi erecti ; rachis recta, robusta, complanata, vel interdum trigona, ad angulos glabra, vix alata, absque ulla linea intramarginali, ornata pedicellis alternatim dispositis brevibus complanatis vel triangularibus, desinentibus in spiculam. *Spicula*



Dimeria santapaui sp. nov.

A. Habit, B. Base of the plant, C. Complete flower, D. Upper glume, E. Lower glume, F. Lemma of lower glume, G. Lemma of upper glume, H. Sex organs, I. Grain.

haud compressa, 7 mm. longa, callo longe barbato ornata. *Gluma inferior* 4-4·5 mm. longa, elliptico-acuta ambitu, recta ad dorsum, alata secus margines, teres infra, omnino glabra, brunnea. *Gluma superior* 7 mm. longa, lanceolato-acuminata, sub-curvata, marginibus alatis, pilis 4-5 longis mollibus albis ornata sub ipso fere apice. *Lemma* inferius squamosum hyalinum lineari-acutum 3 mm. longum. *Palea* nulla. *Lemma superius* lineari-acutum, hyalinum, ad apicem fissum in duos lobos breves, 3 mm. longum, aristatum in sinu ; arista 26-27 mm. longa ; aristae columna torta, brunnea, 2-8 mm. longa. *Stamina* 2, antherae 1-1·5 mm. longae ; styli 2, stigmata 2, libera, plumosa. *Granum* lineare, compressum.

Holotypus, *Sedgwick & Bell* 6875, lectus ad Mirjan in Kanara septentrionali mense octobri anni 1919 et positus in BLAT, Bombay ; isotypus sub eodem numero positus in Horto Kewensi (K) in Anglia.

Dimeria santapaui sp. nov.

This species differs from all the other species of the genus *Dimeria* previously described from India, because of its solitary raceme.

An annual grass. Culms up to 15 cm. tall, erect from the base, terete, glabrous, with long weak hairs just below the nodes which cover completely the nodal region. Lower leaves linear-acuminate, erect, up to 5 cm. long, 2 mm. broad, glabrous and scabrid all over ; upper leaves about 3·5 cm. long, glabrous, acute or subacute ; sheath very tight and covers up to half of the internodes, not keeled, slightly hyaline along the margins.

Inflorescence solitary raceme, up to 2 cm. long, straight, consisting of 2-7 spikelets terminal on a long-exserted peduncle ; rachis straight, stout, flat or sometimes trigonous, edges glabrous, hardly winged, without an intra-marginal line, furnished with alternately arranged short pedicels; pedicels flat or triangular, terminating into a spikelet which is not compressed, 7 mm. long, with a long bearded callus. Lower glume 4-4·5 mm. long, elliptic-acute in profile, straight on the back, winged along the margins, terete below, glabrous all over, dark-brown. Upper glume 7 mm. long, lanceolate-acuminate, slightly curved, margins winged, with 4-5 long, soft, white hairs just little below the tip. Lower lemma, a hyaline linear-acute scale, 3 mm. long ; palea absent. Upper lemma linear-acute, hyaline, cleft at the tip into two short lobes, 3 mm. long, awned in the sinus ; awn 26-27 mm. long ; column of the awn twisted, dark-brown, 7-8 mm. long ; stamens 2 ; anthers 1-1·5 mm. long ; styles 2 ; stigmas 2, free, plumose ; grain linear, compressed.

Holotype of this species is, *Sedgwick & Bell* 6875, from Mirjan flats, North Kanara, collected in October 1919 and is kept in BLAT. Isotype 6875A is the duplicate specimen from the holotype and it is deposited in

Kew Herbarium (K), in England. This new taxon has been separated from Sedgwick & Bell herbarium, from species folder of *Dimeria woodrowii* Stapf.

Ischaemum borii sp. nov.

Affine *Ischaemo diplopogoni* Hook. f., a quo tamen differt arista sat longa, et gluma inferiore ornata aristis conspicue longis.

Gramen annuum erectum, ad 15 cm. altum, ramosum e basi; internodia ad 4 cm. longa, nodis pilosis. *Folia* sagittata, 3·5 cm. longa 7.5 mm. lata, lineari-lanceolata, acuta vel acuminata, eminenter nervosa et nitentia in pagina exteriore; foliorum vaginae ad 3 cm. longae, compressae, lanceolatae, glabrae; petiolis brevissimis. *Inflorescentia* constat spicis duabus immersis in vaginam spathiformem; spiculae in paribus, quarum altera pedicellata, altera sessilis, utraque ad maturitatem e basi scindenda. *Spicula sessilis* bisexualis. *Gluma superior* 4-5 mm. longa, lanceolata, tumescens ad utrumque latus in medio dimidii inferioris, ornata duplici fasciculo capillorum ad margines in dimidio superiore, nervosa ad dorsum, apice bifido, lobis aristatis, arista armata introrsum. *Gluma inferior* 4-5 mm. longa, lanceolata, basi angustiore, capillis fasciculatis ad centum; apice bilobo, arista longa emergente e sinu, introrsum armata. *Lemma superius* hyalinum, naviculare, acuminate bilobum ad apicem, arista longa emergente e sinu, ca. 6 cm. longa, introrsum armata. *Lemma inferius* hyalinum, naviculare, 3-3·5 mm. longum, anguste inversum ad margines. *Paleae* 2, hyalinae, 2·5-3 mm. longae, lanceolatae, acutae. *Stamina* 3, introrsa, filamentis ad 1 mm. longis; antherae ad 1·5 mm. longae. *Ovarium* elongatum; stigma plumosum. *Spiculae pedicellatae* steriles. *Gluma superior* lineari-lanceolata, aristata, viridis. *Gluma inferior* papyracea, lineari-lanceolata, ciliata ad dorsum, bifida ad apicem, lobis brevissime aristatis.

Holotypus, *MRA* 895, et isotypus, *MRA* 895*A*, lecti in saxis madidis ad cataractam ad Amboli prope Savantwadi die 24 decembris anni 1968 et positi, holotypus in K, isotypus in BLAT; paratypus, *Patwardhan* 1115, lectus ad Ambewadi die 12 decembris anni 1907 in saxis madidis ad cataractam, positus in BLAT.

Ischaemum borii sp. nov.

This species is allied to *Ischaemum diplopogon* Hook. f. but differs from it in having considerably long awn and a remarkably long aristae on the lower glume.

An annual erect grass up to 15 cm. tall branching upwards from the base. Internodes up to 4 cm. apart; nodes hairy. Leaves sagittate, up to 3·5 cm. long, 7·5 mm. broad, linear-lanceolate, acute or acuminate, prominently veined and shining on the outer surface ; leaf-sheaths up to 3 cm. long, compressed, lanceolate, glabrous ; petiole very short. Inflorescence of two spikes embedded into a spathiform sheath ; spikelets in pairs ; one pedicelled and other sessile, both breaking from the base at

Ischaemum borii spn .ov.

A. Habit, B. One pair of spikelets—with dorsal view of upper glume, C. Lower glume, D. Upper lemma, E. Lower lemma, F. Upper paleae, G. Lower paleae, H. Sex organs.

maturity. Sessile spikelet hermaphrodite ; upper glume 4-5 mm. long, lanceolate, bulging on either sides on the middle of the lower half, with two tufts of hairs of the margin of the upper half, nerved on the back ; apex bifid ; lobes aristate ; arista introrsely barbed. Lower glume

4-5 mm. long, lanceolate, with narrower base, with tufted hairs in the centre ; apex bilobed, giving out a long arista from the centre ; aristae introrsely barbed. Upper lemma hyaline, boat-shaped, acuminately two lobed at the apex and giving out a long awn from the centre awn about 6 cm. long, introrsely barbed. Lower lemma hyaline, boat-shaped, 3-3·5 mm. long, narrowly inturned along the margins. Paleae 2, hyaline, 2·5-3 mm. long, lanceolate, acute. Stamens 3, introse ; filaments up to 1 mm. long. Ovary elongated ; stigma plumose.

Pedicelled spikelets sterile. Upper glume linear-lanceolate, aristate, green. Lower glume papery, linear-lanceolate, ciliate on the back, bifid at the apex ; lobes very shortly aristate.

Holotype of this species is *MRA* 895, collected from Amboli, Savantwadi, on 24th December, 1968, on moist rocks near the waterfall. Isotype *MRA* 895*A* (BLAT) is the duplicate of holotype. Paratype *G. B. Patwardhan* 1115, collected from Ambewadi, on 12th October, 1907, on moist rocks near waterfall is also deposited at BLAT.

Arthraxon satarensis sp. nov.

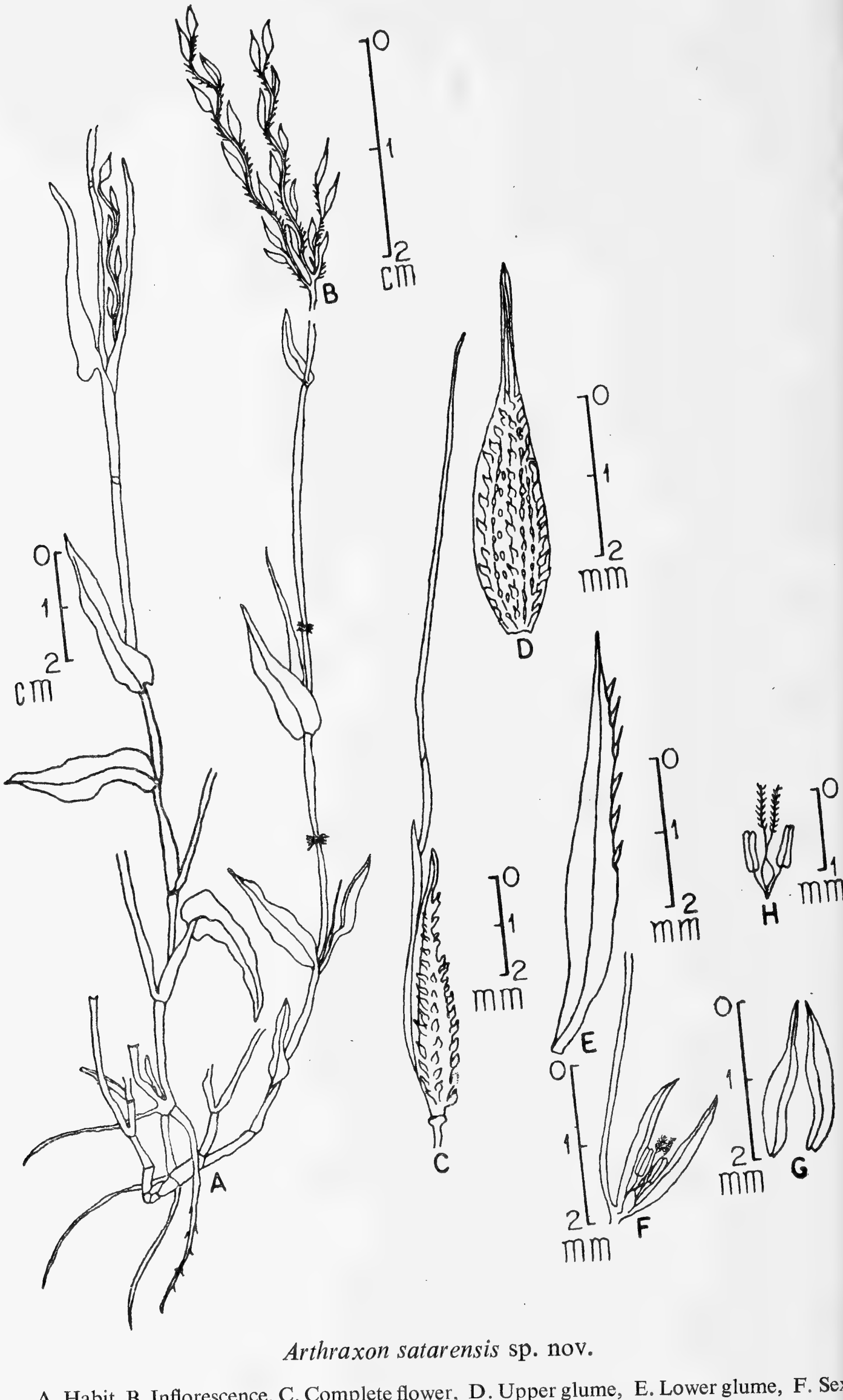
Affinis *Arthraxoni purandharensi* Bhar., a quo tamen differt spiculis solitariis et tuberculis non ciliatis in dimidio superiore glumae inferioris.

Gramen perenne, ad 40 cm. altum, robustum, ramosum e nodis, qui sunt pubescentes et rubro-brunnei. *Foliorum lamina* ovato-lanceolata, acuminata, late amplexicaulia ad basin, ad 3 cm. longa, pilosa pilis nitentibus e basi bulbosa oriundis in pagina superiore, ad margines ciliata pilis bulbosis, nervo medio eminenti. Vagina ad 2·5 cm. longa, arcte culmos amplectens, pulchre sulcata et pubescens. Ligula *c.* 1 mm. longa, scariosa. *Inflorescentia* constans racemis axillaribus et terminalibus paniculatis, ad 4 cm. longis ; rachis pilosa articulis tumescentibus. Spiculae solitariae, lateraliter, compressae, sessiles, 6 cm. longae, anguste lineari-lanceolatae, callo nullo. *Gluma inferior* 5 mm. longa, lineari-lanceolata, curva ad dorsum, carinis serratim muricatis' secus totam longitudinem glumae, ciliata ad apicem. *Gluma superior* 6 mm. longa, navicularis, acuminata, chartecea, nervosa, marginibus hyalinis. *Palea inferior* 2 mm. longa, lineari-lanceolata, acuta, hyalina, vacua. *Palea superior* 2 mm. longa, lineari-lanceolata, acuta, aristata ; arista ad 16 mm. longa emergente e basi paleae. *Stamina* 2, *c.* 1 mm. longa ; antherarum thecae 0·5 longae. *Stigmata* 2, plumosa.

Holotypus positus in BLAT sub notatione ' 8. *Satara-Keshyaturda* '. Isotypus, pars eiusdem shedae ac typus, positus in K.

Arthraxon satarensis sp. nov.

Allied to *Arthraxon purandharensis* Bhar., but it differs from it in having solitary spikelets and non ciliated tubercles on the upper half of the lower glume.



Arthraxon satarensis sp. nov.

A. Habit, B. Inflorescence, C. Complete flower, D. Upper glume, E. Lower glume, F. Sex organs with paleae and arista, G. Palea, H. Sex organs.

A perennial grass. Culms up to 40 cm. tall, robust, branching at the nodes which are pubescent and reddish-brown. Leaf-blade ovate-lanceolate, acuminate, base broadly amplexicaulous, up to 3 cm. long, covered with bulbous based shiny hairs on the upper surface, ciliate on the margins with the bulbous hairs, midrib prominent. Sheath up to 2·5 cm. long, closely attached to the culms, finely grooved and pubescent. Ligule about 1 mm. long and scarious. Inflorescence of axillary and terminal racemous panicles. Racemes up to 4 cm. long; rachis hairy, joints of the rachis swollen. Spikelets solitary, laterally compressed, sessile, 6 cm. long, narrowly linear-lanceolate, callus absent. Lower glume 5 mm. long, linear-lanceolate, curved on the back, keels serrately muricate, murications along the entire length of the glume, ciliate at the apex. Upper glume 6 cm. long, boat-shaped, acuminate, charteceous, nerved, with hyaline margins. Lower palea 2 mm. long, linear-lanceolate, acute, hyaline, empty. Upper palea 2 mm. long, linear-lanceolate, acute, aristate; awn up to 16 mm. long, arising from the base of the palea. Stamens 2, about 1 mm. long; anther cells 0·5 mm. long. Stigma 2, plumose.

Holotype (BLAT) of this species is the specimen 8. *Satara-Keshyaturda*. Isotype (K) is the part of the material from the same sheet of holotype. On the original sheet there was no date or any other information other than '8. Satara-Keshyaturda'.

Acknowledgements

I wish to acknowledge my sincere gratitude to: Dr. N. L. Bor, Kew, England, for confirming the identification of the three new taxa; to Rev. Fr. H. Santapau, for going through the manuscript and for the latin diagnoses of the taxa; to Prof. P. V. Bole, for encouragement and guidance, and to the authorities of Blatter Herbarium and St. Xavier's College for facilities given to me for the preparation of this paper.

Studies on the occurrence and Biology of *Rhinomugil corsula* Hamilton in Krishnagiri and Sathanur Reservoirs, Tamil Nadu

BY

V. RANGANATHAN[1] AND V. NATARAJAN[2]
Fresh Water Biological Research Station, Bhavanisagar

(*With eight text-figures*)

Since its sudden appearance from inadvertent introduction, *Rhinomugil corsula* now forms a considerable fishery wealth in Krishnagiri and Sathanur Reservoirs, offering a new variety of fish to the consumer. The trend in the size frequency distribution, length-weight relationship and condition factor has been discussed. The uniform higher 'K' factor at Sathanur Reservoir is explained with the background of the limnology of the impoundment. The fish is predominantly a mud feeder, browsing in shallow areas and ingesting very commonly algal filaments. In spite of its fluviatile nature, the instance of the species breeding under lacustrine habitat in the absence of monsoon and floods is brought out. The present slackness in the commercial exploitation and scope for cultural possibility in Tamil Nadu of the fish are elucidated.

INTRODUCTION

With the formation of a number of artificial multipurpose impoundments, the programme of inland fisheries development has assumed paramount significance. Tamil Nadu with its chain of such artificial 'lakes' has made use of these extensive water bodies for fish production. This development programme envisages introduction of suitable exotic fishes taking into consideration the zone of location of the reservoir, growth rate, feeding and breeding habits of the fishes, nature of the waters and the subsequent management in respect of conservation and regulated exploitation to obtain a continuous and sustained fisheries. The fisheries of *Catla*, *Rohu*, *Mrigal* and *Calbasu* in the river systems and reservoirs of the plains and those of Mirror Carp and Trout in the hills are a few instances of the exotic species flourishing in new environs along with the indigenous species. In this context, the unexpected appearance and the successful establishment within a short span, of a fishery of *Rhinomugil*

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[1] Deceased.
[2] Assistant Director of Fisheries, Training Centre, Nagapattinam, Tamil Nadu.

corsula, a fresh water grey mullet in Krishnagiri and Sathanur Reservoirs is unique and important as it has good potential as a fish of commercial value in view of its prolific breeding and repopulation.

Material and Methods

Specimens were collected by means of cast nets along the fringes of the reservoirs, and the river within one kilometre below the dams. Other means of capture like Rangoon nets, drag nets etc., proved inefficient on account of the fish evading capture because of its aerial vision and large samplings could not be made. The fish were measured while fresh for total, and standard lengths, height and girth, correct to the nearest mm. and weighed individually correct to the gm. The biometric measurements recorded were made according to standard procedures. Scale samples for the study of age and growth were removed at the region just in front of the first dorsal fin where these are the largest. In all cases of availability, the gut contents were taken and gonad condition recorded.

Krishnagiri and Sathanur Reservoirs

The two reservoirs, Krishnagiri and Sathanur are basin-like artificial impoundments, formed as a result of damming the River Ponniar, a seasonal river arising from the south-eastern slopes of the Chennakesava Hills in the Mysore plateau and draining into the Bay of Bengal at Cuddalore in South Arcot District of Tamil Nadu. The length of the river from its source to the sea is 260 miles and except for short spells of heavy rains during south-west and north-east monsoons rarely receives copious and continuous supply of water. The two impoundments are separated by an intermediate river stretch of 67 miles, the upper dam at Krishnagiri has a reservoir capacity of 2410 m.c. ft. and water spread area extending to 3085 acres. Sathanur Reservoir is nearly double this capacity with 4600 m.c. ft. and water spread area of 3100 acres. Both impoundments are characterised by the absence of natural barriers, thereby providing easy access to migrating fish. A detailed description of the two reservoirs with limnological account is given by Sreenivasan (1968).

Distribution and Occurrence

Hamilton (1822) recorded the species from most rivers of the Gangetic provinces and in the southern parts of Bengal. Day (1878) gives the rivers and estuaries of Bengal and Burma as the habitat of this species, in fresh water far above tidal influence. The species has a wide range of natural habitat, estuaries and rivers and also in the regions far above the tidal influence in fresh water. Quite in contrast to its wide ranging habitat, the fish has a very limited distribution, in that the species is known to occur outside India only in the rivers and estuaries of Burma.

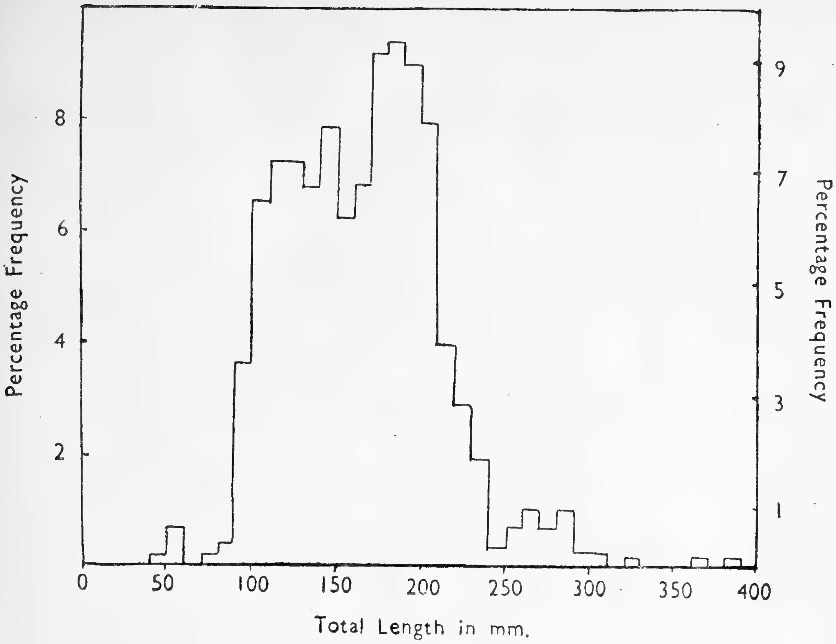
The occurrence and establishment of the *Rhinomugil corsula* fishery south of Mahanadhi has not been recorded so far. Chaudhury (1917), Hora (1923), Devasundaram (1951, 1954) and Jones & Sujansingani (1954) have reported the availability of this fish in Chilka Lake. Basu (1946) gives an account of the introduction of two small consignments one by Dr. Job at Madras and the other by Dr. Hora at Visakhapatnam. No further information is available on the species.

The occurrence of *Rhinomugil corsula* in Krishnagiri and Sathanur Reservoirs of Tamil Nadu is the result of an accidental stocking. Sathanur Reservoir was taken up for fish culture in 1959 and Krishnagiri Reservoir in 1960, by stocking annually 2000 to 5000 fry of major carps mainly *Rohu* and *Mrigal* imported from Calcutta in addition to fingerlings of *Catla*, *Calbasu* and *Mrigal* received from Thanjavur Delta. It is likely that small numbers of *Rhinomugil corsula* spawn or fry might have been inadvertently introduced around 1960 along with the carp fry from Calcutta and the result was evidenced during 1963, when large numbers of the characteristic fry and fingerlings and a few fish of two and three year groups were noticed in both these two impoundments. The remarkable establishment of the fishery within a short span of three years and its subsequent breeding year after year in the new ecological niche on an extensive scale are noteworthy.

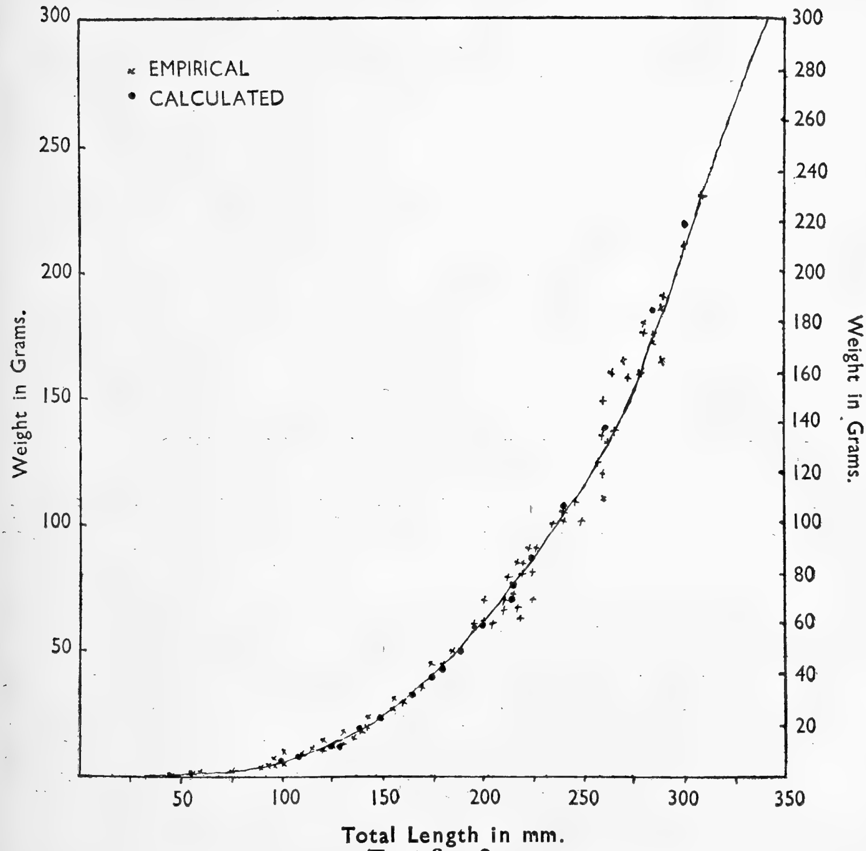
LENGTH FREQUENCY DISTRIBUTION

Studies on the length frequency were made from the data obtained from 922 specimens collected between May, 1964 and December, 1965 from the Krishnagiri and Sathanur Reservoirs. The month-wise picture showing the trend of length frequency distribution is not attempted owing to the small numbers captured and the failure to collect samples during certain months. Hence the data gathered till December 1965 from both reservoirs were pooled and grouped into small size ranges of 10 mm. class intervals.

Text-fig. 1 depicts the length frequency distribution of the fish in the two reservoirs. Petersen's principle to separate out the year classes holds good in a population of a species of fish having a single restricted spawning season. *Rhinomugil corsula* has a breeding period limited to June, July and August corresponding to the south-west monsoon and hence offers a suitable study on the length frequency based on the Petersen's method. The length at various ages, as derived from the modes of the length frequency histogram are I year=120 mm. ; II year=

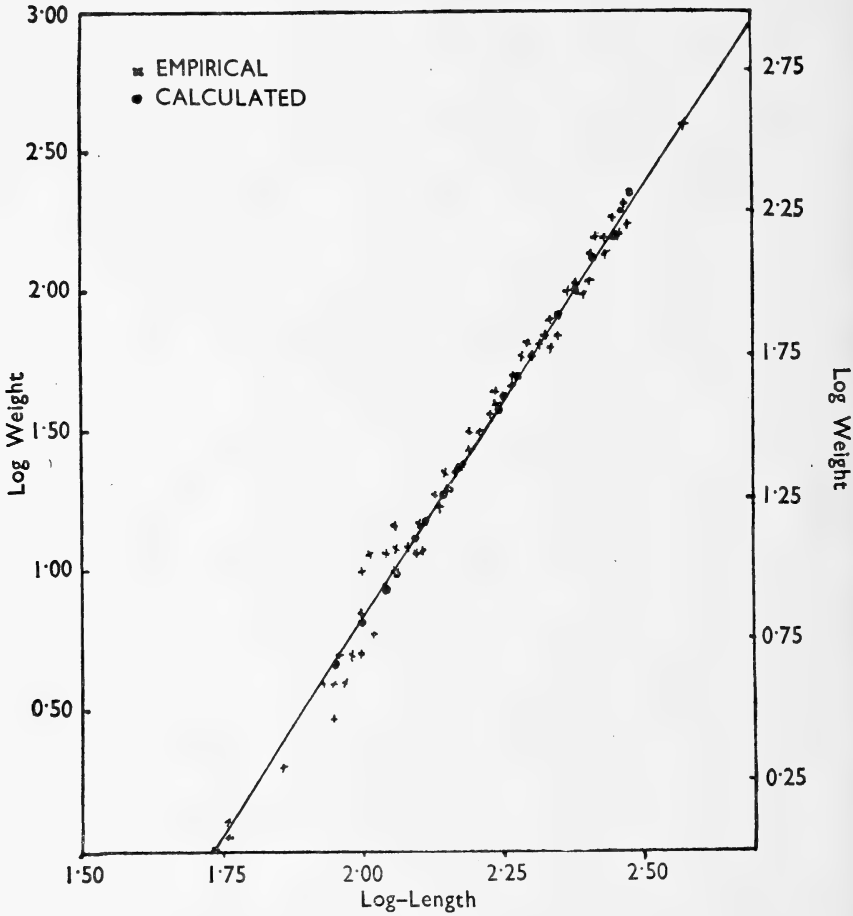


Text-fig. 1.
Length frequency distribution in Percentage in Krishnagiri and Sathanur Reservoirs.



Text-fig. 2.
Length-Weight Relationship in Krishnagiri Reservoir.

185 mm.; III year=265 mm.; IV year=325 mm.; V year=365 mm. Whereas the maximum recorded length of fish is 385 mm. in Krishnagiri Reservoir, that at Sathanur Reservoir is only 320 mm. Sampling error



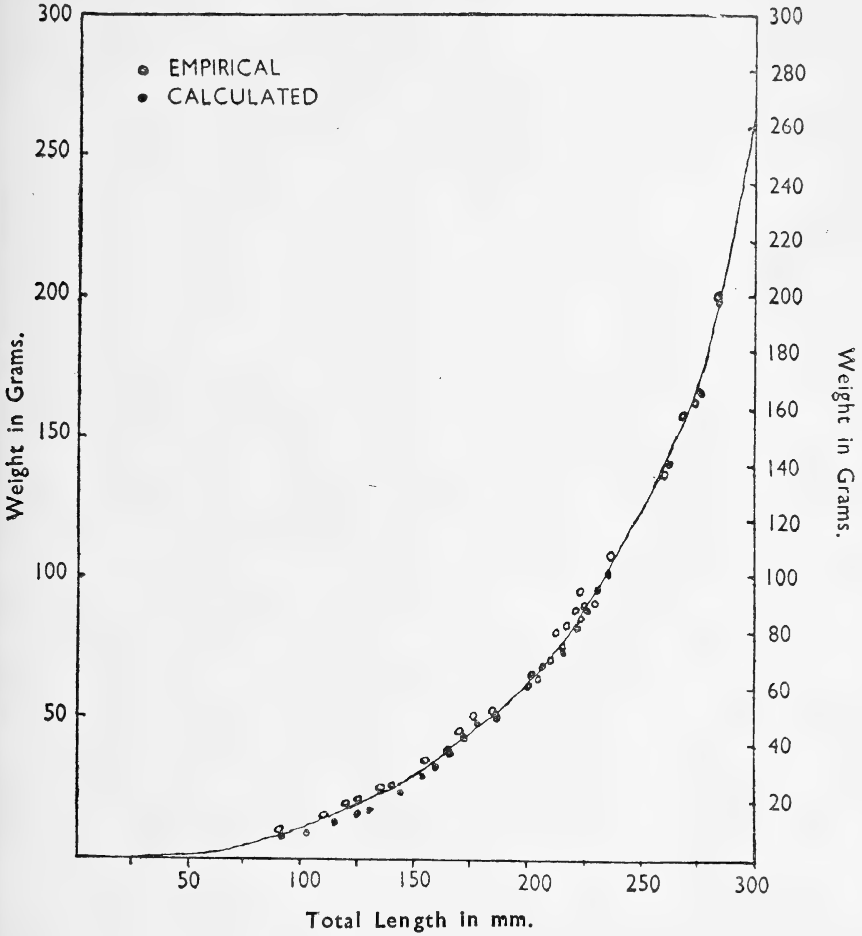
Text-fig. 3.

Log Length-Log Weight Relationship in Krishnagiri Reservoir.

may inevitably be the cause for this or possibly, the initial introduction might have been at Krishnagiri Reservoir, from where the species could have made its way down to the Sathanur Reservoir.

Length-weight relationship

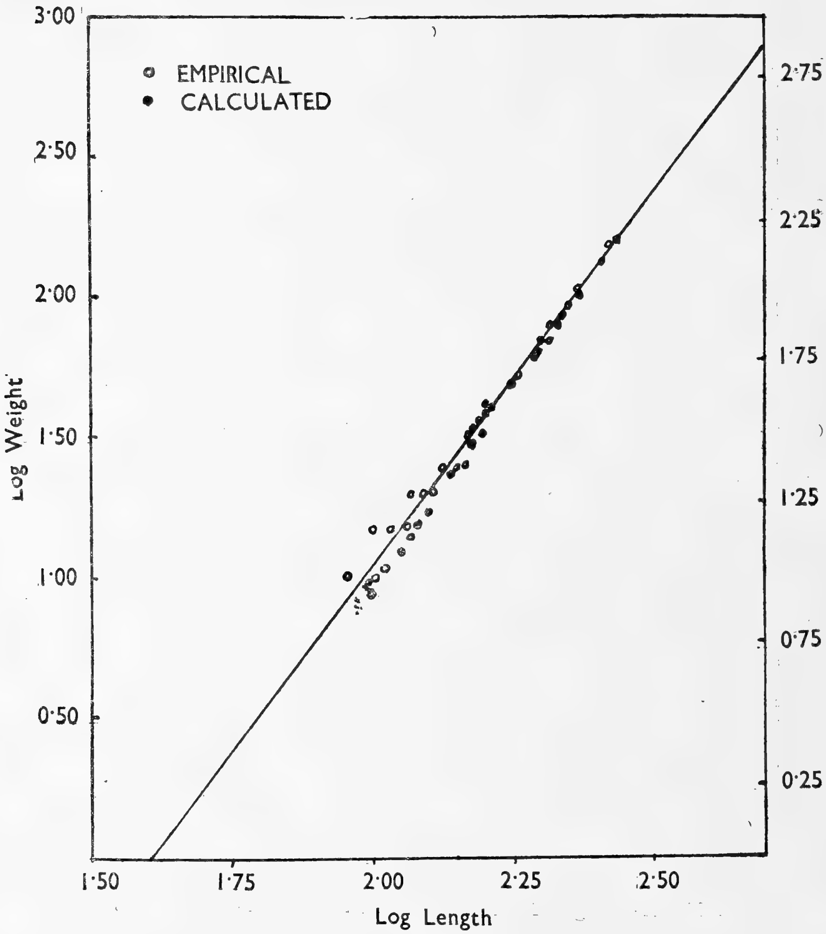
The relationships between length and weight were determined separately for the fish at Krishnagiri and Sathanur Reservoirs. A total of 710 and 156 specimens were sampled from Krishnagiri and Sathanur Reservoirs respectively. The length-weight relationship was fitted into the formula $W=cL^n$ or expressed logarithmically as $\log W=\log c+n \log L$, where W is the weight in gm., L, the total length in mm. and c and n are constants. The values of c and n were derived by means of formulae given by Lagler (1952).



Text-fig. 4.

Length-Weight Relationship in Sathanur Reservoir.

Text-fig. 2 shows the relationship between length and weight whereas text-fig. 3 depicts the regression of log length on log weight of *Rhinomugil corsula* in Krishnagiri Reservoir. Text-figs. 4 and 5 show the relationships between length and weight, and log length and log weight of *Rhinomugil corsula* of Sathanur Reservoir. In both instances it is seen that curvilinear relationship is obtained between length and weight, as the growth in length and weight is not proportionate, and the weight increases as the power of length. When the variables of length and weight were converted in terms of logarithms as log length and log weight, the relationship assumes straightline as evidenced by the text-figs. 3 and 5. As could be seen from the parabola (Text-figs. 2 and 4), the gain in weight gets momentum when the fish reaches a size of about 150 and 125 mm. respectively in the case of fish at Krishnagiri and Sathanur Reservoirs.



Text-fig. 5.

Log Length-Log Weight Relationship in Sathanur Reservoir.

The length-weight relationship of *Rhinomugil corsula* of Krishnagiri Reservoir is fitted in the following equation :

$$W=3{\cdot}340\times10^{-5}\times L^{3{\cdot}1755}$$

or logarithmically

$$\log W=-5{\cdot}5238+3{\cdot}1755 \log. L.$$

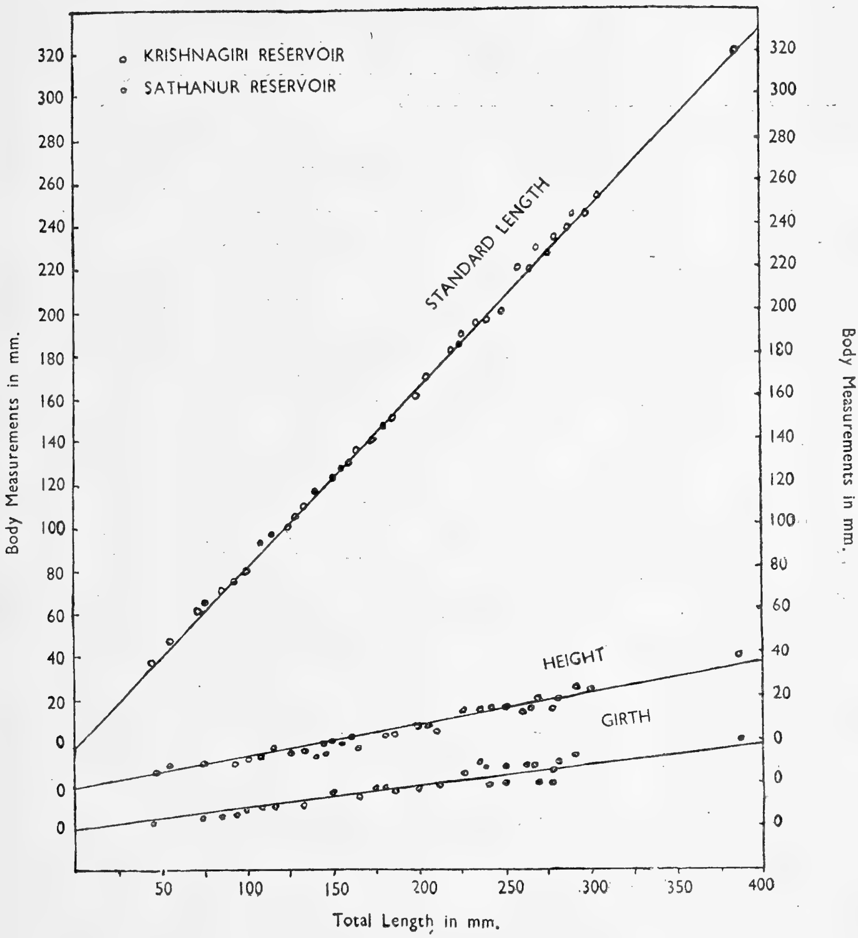
The relationship in the case of *Rhinomugil corsula* of Sathanur Reservoir is framed in the equation :

$$W = 1{\cdot}255 + 10^{-5} \times L^{3{\cdot}0026}$$

or logarithmically

$$\log W = -5{\cdot}098 + 3{\cdot}0026 \log L.$$

The equations derived above depict the length-weight relationships irrespective of size and sex. The correctness of the formulae in the applica-



Text-fig. 6.

Relationship between Total Length and Body Measurements.

tion of the length-weight relationship of the fish has been tested by comparing the calculated weights with the empirical ones and these were found to agree very closely as shown in Text-figs. 2 to 5. Hence these formulae can be conveniently used for conversion of one measure into the other. In both reservoirs, the 'n' value is greater than 3, thus showing that the weight increases at a faster rate than the cube of the length, a condition also met with by Govindan (1961) for *Perca flavescens*.

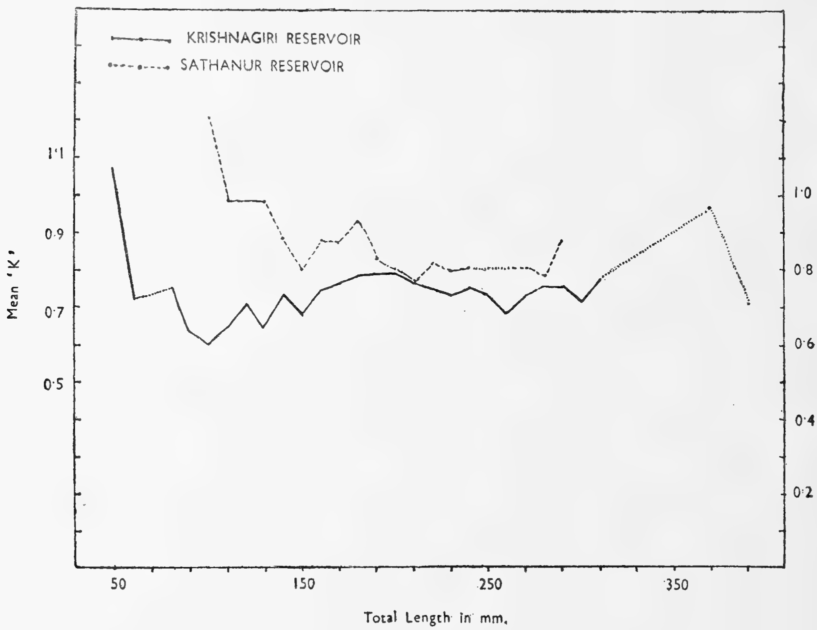
Relationship between total length and body measurements

Text-fig. 6 illustrates the relationship between total length and body measurements namely standard length, height and girth, plotted for the two reservoirs together.

In all cases, linear relationship is obtained, showing that with the increase in the total length of the fish, there is corresponding increase in the length of the body measurements.

Condition Factor

The study of the condition factor has been made with the use, of the formula $K=10^5W/L^3$, where K is the condition factor



Text-fig. 7.

Mean 'K' Factor at Length Groups in Krishnagiri and Sathanur Reservoirs.

W, the weight in grammes and L, the length in mm. The factor gives expression to the relative plumpness of the fish and in turn is a measure to evaluate the fertility and the productivity of the water. Sreenivasan (1964) gives the condition coefficient of mirror carps in different waters, both of hills and plains, which varies with reference to the hydrology and productivity of the waters and the quality of the soil, the condition factor being uniformly higher in eutrophic waters. The following table gives the mean ' K ' values for different months, when samples of *Rhinomugil corsula* were collected, irrespective of size and sex studied separately for the Krishnagiri and Sathanur Reservoirs, thus showing the fluctuations in the mean ' K ' values with reference to the season and locality.

Month		Krishnagiri Reservoir Mean ' K '	Sathanur Reservoir Mean ' K '
May, 1964	..	1·0557 (12)	—
December, 1964	..	0·7517 (7)	—
April, 1965	..	0·7263 (68)	0·7812 (25)
August, 1965	..	0·7023 (222)	0·8530 (35)
September, 1965	..	0·7794 (131)	—
October, 1965	..	0·7718 (246)	1·0019 (70)
December, 1965	..	—	0·80135 (21)

(Numbers in parentheses indicate the number of fish sampled each month)

Generally in fishes, the increase in condition factor is attributable to the gain in weight accompanied by the maturation of gonads during the pre-spawning period and the sharp decline in the values is the result of the mature fishes becoming spent, leading consequently to the lowering of weight and of the condition. Seasonal cycle in the condition factor is considered as an index to determine the spawning season (Le Cren 1951 ; Pillay 1954 ; Sarojini 1957, 1958).

In the present table, no definite pattern in the fluctuation of the ' K ' values could be discerned to interpret the increase or decrease of the condition co-efficient with the maturation or spawning or with the differential feeding intensity. Moreover, the failure to study the factor each month brought in discontinuity and hampered the possible interpretation. However, the figures bring to light the one conclusion that the ' condition ' of the fish is better at Sathanur than that at Krishnagiri Reservoir, as evidenced by the higher ' K ' values in the former.

Text-fig. 7 pictures the fluctuations of mean ' K ' of *Rhinomugil corsula* at 10 mm. class intervals, shown separately for Krishnagiri and Sathanur Reservoirs. It is quite evident that at each size interval, the ' K ' factor is higher in the latter, confirming the inference drawn under seasonal condition. Sreenivasan (1968) has made a comparative study on the limnology of these two hardwater reservoirs. The invariably warmer temperatures, higher alkalinity, total hardness, electrical conductivity, the total dissolved solids content being over 300 ppm. indicating its ' saline ' nature, higher silicate content, the dominance of *Microcystis*, the higher primary productivity ranging from 1·81 to 14·1 g o_2/m^2/day and the higher calcium content are possibly the factors that could have had their influence, leading to the increasing trend of the 'K' factor in Sathanur Reservoir.

Food and feeding habits

Khanna (1961) has studied the alimentary tracts of some teleostean fishes, wherein the different structural modifications met with in the various species were correlated with the food and feeding habits. *Rhinomugil corsula* is predominantly a mud feeder and characterised by the presence of longer gut and muscular bulb at pyloric end. The species consumes large quantities of sand or mud and the organic matter present is utilised for its nutritional needs. Sreenivasan (1968) feels that the high organic matter of the bottom deposits may be directly used as food by these fishes. The fish browses along the shallows, the bottom mud and algae forming the major part of its food constituents and the presence of longer gut and muscular gizzard are adaptations to extract the nutrients present in the food. Similar food and feeding habits have been described by Thomson (1954) for some Australian mullets. An identical account on the feeding of *Mugil dobula* is given by Kesteven (1942). Our observations also support the view of Jones & Sujansingani (loc. cit.) that spent specimens were found gorged with fine bottom scum indicating voracious feeding soon after spawning. *Rhinomugil corsula* is also capable of surface feeding. The aerial vision and the position of the mouth just near the water surface aid in gulping floating materials. No instance has ever been noted of the fish preying upon insects as described by Hora (1938), nor were any insect remains detected in the gut contents, though these two reservoirs harbour plenty of insects and their larvae.

Maturation, Fecundity and Spawning

The progress in the maturation of the fish could not be studied, as only in a few among the fish collected sex was distinguishable and gonads developed. Hence the stages leading to maturation and spawning were not ascertained. Yet, the presence in abundance of the characteristic fry during August and September indicates that the species matures by May and June and spawns around June and July. The fish attains maturity at a size range of 170-200 mm. when the fish is in its second year.

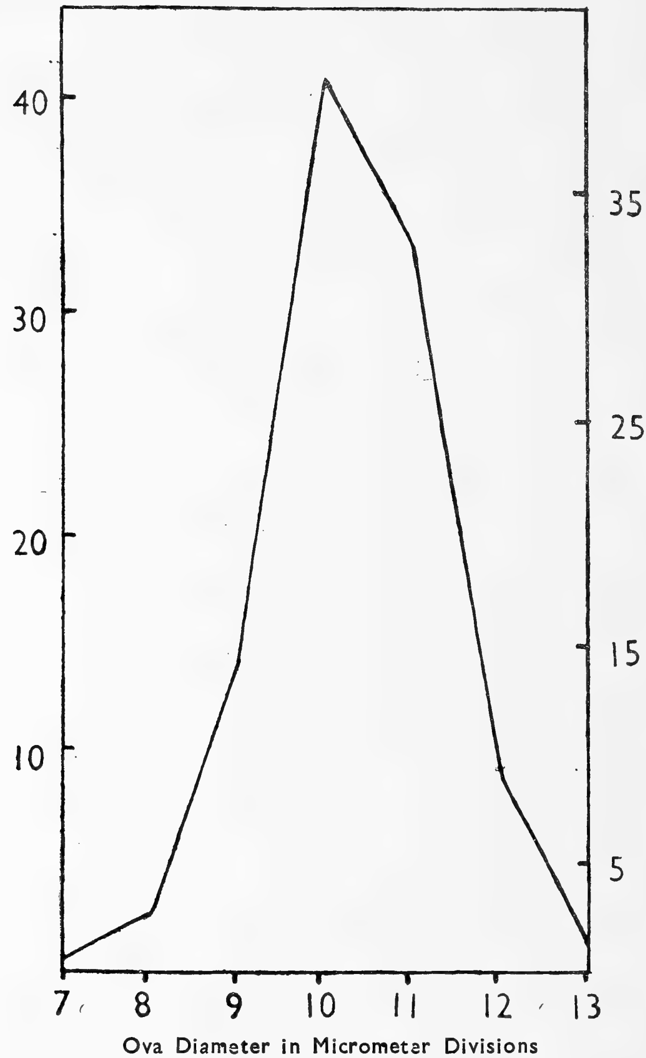
Due to non-availability of large number of mature samples, the range of fecundity of the fish was not estimated. But in a specimen with a length of 284 mm. and a weight of 172 gm., ovary in the fourth stage of development was obtained. Random samples of the ovary were taken, and one cc. of ovary thus removed contained by individual count

3705 numbers of ova. The fecundity of the fish was estimated at 46,500. In older age groups, the fecundity would be still higher.

Hora (1938) presumed March and April, as the peak period of breeding for the species based on the appearance of a large number of young ones in the settling tanks and filter beds of the Water Works at Pulta during these months. He states '*M. corsula* presumably breeds in the river and the connected waters and also in *confined* waters such as those of the Pulta Water Works. The presence of the fish in an isolated settling tank after cleaning shows that the fish must have come in a very early stage of development. This also indicates that *M. corsula* is in reality a fluviatile form and its occurrence in confined water at Pulta is purely accidental.' Chaudhuri (loc. cit.) believes the fish to breed in the rivers the young ones being carried down into Chilka Lake. Jones & Sujansingani (loc. cit.) record the breeding of the species during the rainy season in the inundated parts of the northern section of the Chilka Lake and in the rivers like the Daya and Bhargavi flowing into it. Fertilised eggs were collected by them during the month of August. Their statement 'It appears that the same fish breeds more than once in a year' lacks proof. Qasim & Qayyum (1961) made a study of the spawning frequencies and breeding seasons of some fresh water fishes by means of size frequency of oocytes. They classify *Rhinomugil corsula* as an annual breeder on account of the presence of single group of oocytes and breeding taking place in rivers during July-September, with the time of maximum spawning in July and August.

Text-fig. 8 illustrates the ova diameter frequency distribution. The diameters were only in between 7 to 13 micrometer divisions, indicating one group of ova for a single spawning confirming that the fish is an annual breeder.

The year 1965 was unique in the absence of south-west monsoon and consequently the breeding of major carps with the onset of monsoon and rush of floods was adversely affected. There was no flow of monsoon floods into both Krishnagiri and Sathanur Reservoirs, to act on the fishes, used to the lacustrine habitat, as an impulse to start breeding migration towards the top waters which are the favourite spawning grounds. *Rhinomugil corsula*, though considered as a fluviatile form, breed in the absence of monsoon floods in both impoundments. Some also entered the Krishnagiri fish farm as spawn through the inlet and developed into tiny fry during August, 1965. The breeding of the fish on a mass scale in a lacustrine habitat without the influence of monsoon and floods is more or less akin to breeding in confined waters and thus some weight is added to the assumption of Hora (1938) about the probable breeding of the fish in confined waters. Basu (loc. cit.) cites De as stating that the species is known to breed in tanks and for this reason, the ponds need only be stocked once after which they will require 'periodic thinnings and no replenishing'. However, no direct observation has been made by us to conclusively say that it breeds in confined waters such as tanks and ponds.



Text-fig. 8.

Ova Diameter Frequency Distribution.

Fishery

Successful breeding of the fish in the course of the last six years has now resulted in a sizable fishery potential in both these reservoirs, and a beginning can be safely made for exploitation on a commercial scale. Fish having maximum length of 385 mm. and weight of 450 gms.

were recorded in our studies. The fish has also entered and populated small and large irrigation tanks like Barur connected to Krishnagiri reservoir and yields considerable fishery in the former. The fish is known to grow just over 45 cm. But the deficiency in size is made up by numbers. The possession of aerial vision by the fish, poses problems in the commercial exploitation, making normal fishing tackle of the reservoir fisheries ineffective. The operation of Rangoon nets with small meshes is not possible as the fish frequents the shallow and surface waters. Shore seine type of nets would be handicapped by the uneven surface and the bottom strewn with rocks, boulders and tree stumps. Cast netting definitely is not the means for commercial capture, as even the slight disturbance caused as a result of the approach of fishermen makes them flee. Chaudhuri (loc. cit.) and Devasundaram (1954) also speak of the ability of the fish in eluding capture. No special fishing device or trap has yet been designed for a commercial exploitation of the *Rhinomugil corsula* fishery in the artificial impoundments.

Cultural possibility

Basu (loc. cit.) and Pillay (1947) have discussed the cultural possibilities of Indian mullets in general. There is wide scope for the culture of *Rhinomugil corsula* in Tamil Nadu as constant supply of seed can be obtained from Ponniar river system and the two reservoirs. Production of the seed by the artificial induced hormone treatment also can be explored. The fish is suitable for culture in association with carps on account of its non-predaceous nature and feeding habits restricted to shallow muddy bottom, surface and consumption of large quantities of algae. Artificial feeding can be done by strewing rice bran on the surface waters. The fish is reported to be of good culinary value. The experimental introduction of the fish in certain Applied Nutrition Programme tanks in Krishnagiri Block and the fish farms at Krishnagiri Project and Bhavanisagar is being studied to throw more light for an extensive culture.

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A Study on the Aquatic Coleoptera of Poona (Maharashtra)

BY

G. T. TONAPI AND V. A. OZARKAR

Department of Zoology, University of Poona, Poona 7 (Maharashtra)

(*With a plate*)

[*Continued from Vol.* **66** (2) : 316]

Orectochilus discifer Walker (Plate V, fig. 17)

The general body shape of this species is rather elongate with the last abdominal segment more or less lengthened like a tail. The elytra are abruptly truncated leaving last two-three segments uncovered. The lateral sides of the pronotum and lateral and posterior parts of elytra are pubescent. Both the surfaces are black and the under surface is more nitid. In the males the front pair of legs is provided with spongy hairs on the tarsal plates. Although this species occurs in the same habitat as that of *Dineutus indicus* it prefers rather fast flowing mountain streams.

Status and Habitat : Common. Streams and temporary water courses.

Measurements : Length 9-10 mm. ; Breadth 3·5 to 4 mm.

Family HYDROPHILIDAE

Hydrophilus olivacious (Fabr.) (Plate V, fig. 18)

This species is long and stout and has its metasternal keel produced into a long spine. Their dark brown dorsal surface is with a tinge of olive green colour while the ventral surface is pubescent. The elytra have four distinct rows of punctures the outermost row being double. Posterior edges of elytra near the suture are with inner emargination. The abdominal sternal plates have yellow spots on the lateral margins. The species inhabits mainly crevices on the bank of ponds or rivers. When disturbed the beetles move into the thin layer of muddy substratum. This species is of common occurrence in this part of Maharashtra though in limited numbers.

Status and Habitat : Common. Pools, quarries and river banks.

Measurements : Length 33 mm. ; Breadth 17 mm.

Hydrophilus indicus (Bedel)

This species is more stocky and stouter than the preceding one. Because of the curvature of the body and the downward projection of the head capsule the thorax looks more or less like a hump. The colour is decidedly Indian black. This species is not at all common as the preceding one. Previous records are mostly from north India but its occurrence at Salem District in south India has also been reported by Vazirani (1952).

Status and Habitat : Uncommon. Pools, quarries and river banks.

Measurements : Length 40 mm. ; Breadth 18 mm.

Sternolophus (*s. str.*) **rufipes** (Fabr.) (Plate V, fig. 19)

The general form of this species is elongately ovate with rather evenly rounded margins. The abdomen often projects a little from beneath the elytra. The thorax and the elytra are pitchy and nitid. The latter are sculptured with ten parallel rows of small minute punctures. All these rows converge posteriorly. The abdominal sternal plates have yellow spots on their lateral sides. The sternum is keeled and is provided with a spine. The ventral surface is pubescent. Vazirani (1952) has recorded that this species is very common in the Oriental region.

Status and Habitat : Uncommon. Pools, river banks, wells and temporary water courses.

Measurements : Length 13 mm. ; Breadth 7 mm.

Regimbartia attenuata (Fabr.) (Plate V, fig. 20)

This is a very common small dark brown species with its head projecting downward. The sternum is keeled but is not produced into a spine. The elytra have nine rows of distinct small punctures which converge posteriorly. The species has been recorded all over the South-east Asia and Australia. The specimens are commonly found on the river banks among the growing vegetative mass of *Vallisneria* and other aquatic plants.

Status and Habitat : Common. Pools, river banks and wells.

Measurements : Length 5 mm. ; Breadth 2 mm.

Hydraena quadricollis Wollaston (Plate V, fig. 21)

This species is very small but has long maxillary palps and a deeply cleft labrum. The antenna is with a five segmented pubescent club. The general body colour is testaceous. The elytra are provided with more than six rows of punctures between the suture and the humeral angle. The under surface is pubescent. The species has always been found to be associated with rotten twigs or grass and crawls among such hollow floating stems. This species has not been previously recorded from India. The earlier records are from some islands in the Atlantic Ocean on the west coast of Africa. The report from India (Tonapi & Ozarkar, In press) further enlarges its recorded range and makes the geographical distribution of the species much more interesting.

Status and Habitat : Rare. Pools, wells and river banks.

Measurements : Length 1·5 mm. ; Breadth 0·5 mm.

General Observations

One of the interesting features that emerges from this study is an uneven picture of the aquatic coleopteran fauna of this part of the country. Considering the continental weather conditions (Tonapi 1959) prevailing in this region it was expected that most of the aquatic beetle families will be well represented. However, the Dytiscids and Hydrophilids predominate. Neither the Gyrinidae nor for that matter the Hydrophilids and Dytiscids are present in large numbers of genera or species. d'Orchymont (1928) has already recorded about three hundred and sixty-three Hydrophilid species from India while Ochs (1930) catalogued nearly one hundred and thirty gyrinid species. Therefore it is surprising that Poona and the adjoining areas having enough aquatic habitats to support a rich fauna do not in reality contain an appreciable number of species or are relatively abundant when compared to aquatic bugs (Tonapi 1959). Perhaps further explorations may yield additional information or more number of species. However, it may be pointed out that earlier field investigations (Tonapi 1959 ; Tonapi & Mulherkar 1963, 1963a) were also aimed at a survey of the beetle population in order to obtain an integrated picture of the biotic world of the fresh waters of Poona. Nevertheless, it cannot be ruled out that more intensive and systematic combing of the area may yield additional data.

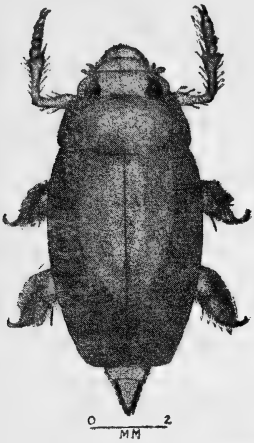
It would also appear from this study that these aquatic beetles usually inhabit cool and undisturbed sheets of water and still more preferably the larger areas of shaded standing waters. However, Gyrinids are definitely not to be found in such habitats. Even so they form their characteristic congress only in the quiet parts of fast flowing streams. In the wet season (July-November) any habitat as a small temporary water course which has deep pools along the flowing stream form a favoured place for this aquatic community. These beetles are scarce in the big lakes of over a hectare in area even with all their manifold niches for aquatic life. It is in the sheltered waters such as pools, discarded wells and other shaded localities that these beetles are found to be in great abundance. In big lakes factors such as wave action, wind velocity and scarcity of emergent vegetation presumably act as deterents (Macan 1963). The small eddies or pools of water with pleuston consisting of *Vallisneria, Hydrilla, Ceratophyllum* and similar but submerged unattached vegetation on the banks provide the necessary shade and suitable substrate to these beetles. It can be seen that even in cement built tanks these beetles prefer to stay near the shaded walls. In discarded wells and other types of waters many floating objects harbour and provide the necessary retreat near the surface where they are often required to come to replenish their gas stores for respiration. Their aerial mode of respiration and their incapacity to remain submerged for a long time also play an important role in their distribution. It is then reasonable that the presence of blanket of algae, or filamentous blue-green algal scum is extremely unfavourable to them since its growth seriously hinders their surfacing activity. The Gyrinids are totally absent in such conditions.

It is interesting to note here that in most of these habitats the fish community is conspicuously absent. Conversely, any well or rock pool showing even a small shoal of fishes was found to have none of the beetle fauna (see also Tonapi 1959; Tonapi & Mulherkar 1963; 1963a). It has also been observed that most of the quarries or ponds where the adult beetle population was maximum in number or species, were devoid of any of their larval developmental stages. By implication it may be concluded that the beetles perhaps move to bigger lakes, rivers and larger tanks for breeding.

The present study has also yielded an interesting correlation between the size of the beetle and the position they occupy in a habitat. The larger beetles were found towards the deepest waters while the smaller species were found towards the shore lines. Thus the four species of the genus *Cybister* and the medium-sized beetles like *Hydaticus* were found more or less in the central region of water and were rarely obtained in the sweeps made at the banks. The smaller beetles were always found on the banks. This is very true in the case of ponds and rock pools found near the river bed which support a rich beetle fauna even in the dry seasons. The Hydrophilids require some kind of anchorage and they always prefer the crevices or the partly submerged rooted vegetation on the banks of a river or a pool. The Dytiscids were invariably collected from ponds, built-up tanks, quarries and discarded wells but very rarely occurred on the river banks.

In the larger areas of waters with a maximum depth of about 10 metres habitat conditions change but slightly and their characteristic population remains constant for a much longer period. Big discarded wells or rock-pools in the river bed thus form always the chief foci of the beetle community. However, the other habitats like semi-perennial pools of waters or temporary streams go dry in the peak summer months. Such habitats even during the short period support a varying population

Tonapi : Aquatic coleoptera.



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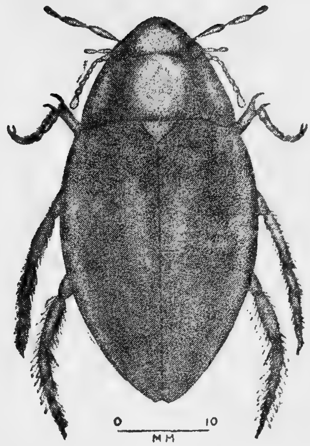

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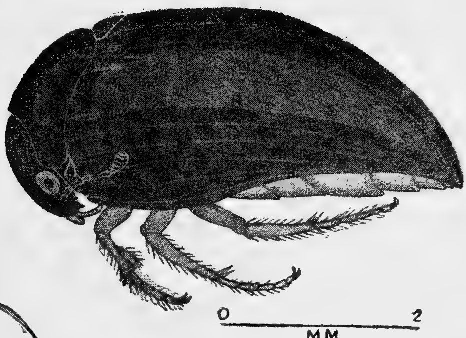

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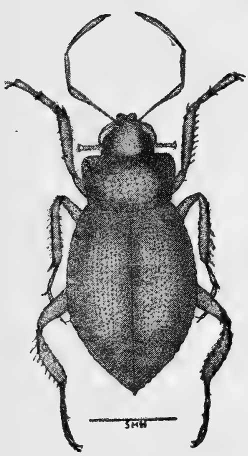

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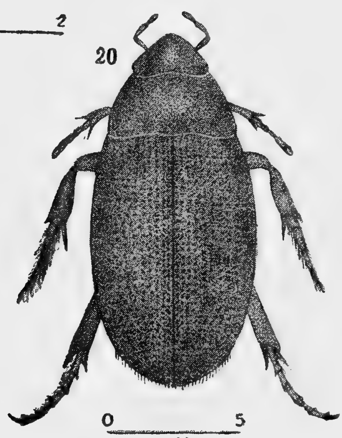

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17. *Orectochilus discifer* Walker ; 18. *Hydrophilus olivacious* (Fabr.) ; 19. *Sternolophus* (*s. str.*) *rufipes* (Fabr.) ; 20. *Regimbartia attenuata* (Fabr.) ; 21. *Hydraena quadricollis* Wollaston.

of the beetle fauna and the population obviously migrates to other nearby favourable habitats during the summer.

Beetle population is quite abundant and active during the months of July to March and during the remaining summer months they are rather difficult to collect. It has, however, been noticed that at cooler places like Khandala, Mahabaleshwar and Matheran which are within the altitude range of 900-1,500 metres and lie within about 100 km. of Poona, the beetle population is quite abundant even in the peak summer months.

Majority of these beetles are good fliers and are attracted towards light during night. They can easily be collected specially around the mercury vapour lamps. Even the smallest beetle like *Hydraena* is capable of flight. It has been noticed to take to flight within fifteen minutes, once it is out of water. This is very interesting since in the British species the amount of wing material was found to be insufficient to make a full-sized wing (see Balfour-Browne 1958 : 180). Beetles of the genus *Laccophilus* make a few hopping movements before taking to wing. Most of the species seem regular fliers and appear to be continuously on the move from one temporary habitat to another. However, their exact range or periodicity of flight is not fully known. Some of the field observations supplemented with the studies of the tracheal anatomy suggest that many of these are migrants. This also seems to explain why even during the Indian summer months the cooler hill stations exhibit a rich and varied beetle fauna even in the non-breeding season. It may not be out of place to comment here on the role of tracheal system in such flight activities. Although the primary function of the tracheal system is to supply oxygen to the body parts, a secondary function as important as the former is to reduce the thoracic metabolic heat generated during flight as noted earlier in Odonata by Miller (1962) and Tonapi (1965). This secondary function is reflected in the tracheal anatomy of not only these beetles (Ozarkar 1967) but also some other insects (Tonapi, unpublished data).

SUMMARY

The paper describes twenty-four species of aquatic beetles found in a variety of habitats of Poona (Maharashtra, India) and its environs. The general physical conditions prevailing in their natural habitats are described. The short descriptions of the beetles are also supplemented with their figures. These are provided with a view to enable one to identify them even in field. The general composition of the beetle fauna is predominated by members of Dytiscidae and Hydrophilidae which are also limited to a few of the usual tropicopolitan genera and species. Gyrinidae is represented only by a single species. The close relationship of the volume of the water and the beetle fauna contained in it has also

been noticed. It has also been suggested that it is in the tracheal anatomy that the adaptations for their amphibious existence are most evident.

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A new Species of *Borreria* Mey, from south India

BY

N. RAVI
Sree Narayana College, Punalur

(*With a plate*)

Borreria eradii sp. nov. (Rubiaceae) from Kerala is described and illustrated.

Borreria eradii sp. nov.

Herba annua, mollis, pilosa, viridescens vel viridi-lutea. *Caules* prostrati, decumbentes vel etiam erecti, ad 150 cm. longi, subquadrati in sectione transversa, eminenter alati, (ala inclusa) ad 8 mm. lati ad basin, alis deorsum setosopilosis, lateribus pubescentibus. Cotyledones orbiculares vel ovatae, apice retuso et vulgo persistentes; *folia* petiolata ad basin, subsessilia ad apicem, late ovata vel ellipsoidea, apice acuto vel subacuto, mollia, puberula in utraque pagina, 4-7-nervia, distincte impressa supra, ad 11·6 cm. longa petiolo incluso et 5·6 cm. lata; vagina stipularis lata, intus glabra, pilosa extus 4-8 setis apicaliter papillatis stipularibus et capillis multicellularibus e basi bulbosa longis. *Flores* ad 20 vel plures in cymis axillaribus, sessiles; sepala 4, penitus pilosa, 2 mm. longa, 1·5 mm. lata; corolla infundibuliformis, decidua, ad 10 mm. longa, ore tumescente ad 5 mm., tubo angusto, lobis 4 triangularibus valvatis; stamina 4, filamentis brevissimis; ovarium viride, pilosissimum, stylo corollae aequilongo tuberculis ornato eminentibus vulgo acutis versus dimidum superius. Fructus 4 mm. longus, 3 mm. latus, lateraliter compressus, pilosus, ventraliter dehiscens in duas valvulas, quae retinent septi partem superiorem, parte inferiore manente in centro. Semina subluteo-brunnea, 2 mm. longa et lata.

Holotypus lectus ad Punalur in St. Kerala, in India meridionali, ab N. Ravi die 20 June 1968 et positus in herb. Coll. Sree Narayana ad Quilon (KERALA) sub numero 2372 A.

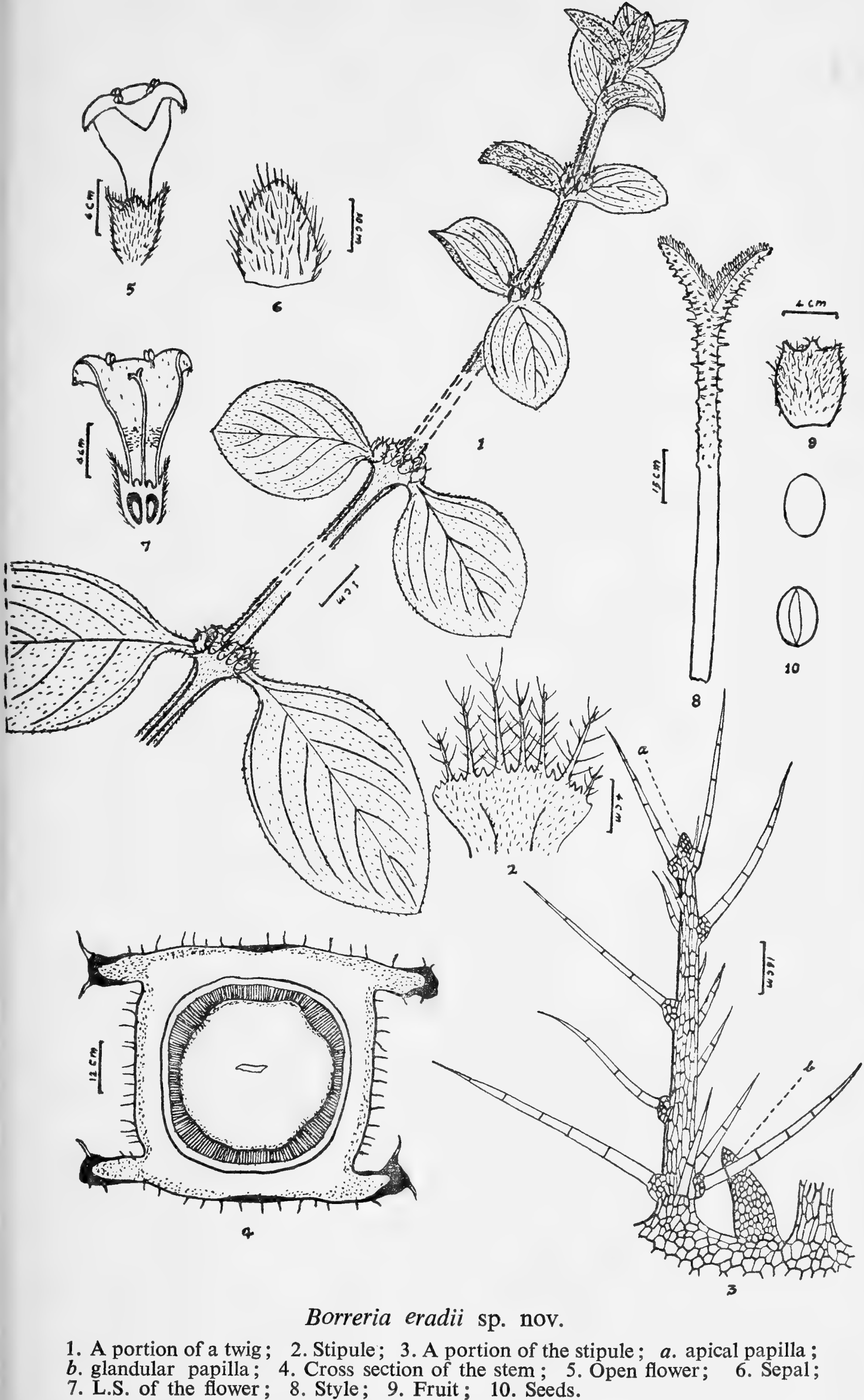
Borreria eradii sp. nov.

Soft, hairy, greenish to greenish yellow annual herb. Stems prostrate, decumbent or even erect, 150 cm. long, more or less square in cross section, sometimes with a hollow pith, prominently winged, 8 mm. wide including the wing at the base, wings downwardly bristly hairy and sides pubescent. Cotyledonary leaves orbicular to ovate with a retuse tip and mostly persistent ; leaves petiolate at the base to almost sessile at the top, blade broadly ovate to ellipsoidal with an acute or subacute tip, soft textured, puberulous on both surfaces, 4 to 7 nerved, distinctly impressed above, 11·6 cm. long including petiole and 5·6 cm. broad ; stipular sheath broad, glabrous within, hairy outside, with 4 to 8 apically papillate stipular bristles interspersed with 8 to 15 small glandular papillae and bearing bulbous based multicellular long hairs. Flowers up to 20 or more in axillary cymes, bracteate, bracteolate, sessile ; sepals 4, subequal, herbaceous, green, oblong ovate, acute or obtuse, hairy throughout, 2 mm. long and 1·5 mm. broad ; corolla funnel-shaped, white with a bluish tinge, fugacious, 10 mm. long, mouth swollen, 5 mm. wide, tube narrow, lobes triangular, valvate with a few bristly hairs at the back of the tip, tube villous in the middle, mouth sparsely hairy ; stamens 4 with short filaments, inserted at the mouth of the corolla, anthers 2-celled, dehiscence introrse longitudinal ; ovary green, very hairy, crowned by persistent sepals and a pair of white or yellowish white glands enclosing the stylar base, 2-celled, each cell one ovuled on axile placentum, style as long as the corolla, simple, slender with prominent mostly pointed tubercles towards the upper half, stigmas 2, linear. Fruits 4 mm. long and 3 mm. broad, laterally compressed, hairy, dehiscing ventrally into 2 valves, the valves carrying along with them the upper part of the septum while the lower part remaining persistent in the centre ; seeds oblong ventrally grooved, shining yellowish brown, granulate, to 3 mm. long and 2 mm. broad.

Holotype collected from Punalur in Kerala State, S. India by N. Ravi on 20th June 1968 and deposited in the Herbarium of the Sree Narayana College, Quilon, No. 2372 A. The paratypes 2372 B-D are deposited in the Central National Herbarium, Botanical Survey of India, Howrah (CAL).

The specimen is being named in honour of my teacher, Prof. N. A. Erady, Maharaja's College, Ernakulam, who has brought to light many new plants from Kerala.

This species has hitherto been referred by some authors to *Borreria hispida* (L) K. Schum. from which it differs in the (1) prominently winged more or less square stem, (2) impressly veined soft textured leaves, (3) apically papillate stipular bristles bearing bulbous based long multicellular hairs and interspersed with glandular papillae, (4) fugacious funnel-shaped corolla with a narrow tube abruptly widening into a swollen mouth and (5) the fruit with the lower part of the septum only remaining persistent after dehiscence. In the dehiscence of the fruit



Borreria eradii sp. nov.

1. A portion of a twig; 2. Stipule; 3. A portion of the stipule; *a.* apical papilla; *b.* glandular papilla; 4. Cross section of the stem; 5. Open flower; 6. Sepal; 7. L.S. of the flower; 8. Style; 9. Fruit; 10. Seeds.

the new species occupies a position intermediate between *B. hispida* (L) K. Schum. and *B. ocymoides* Burm. and in the soft textured impressly veined leaves it resembles *B. stricta* (L.f.) K. Schum.

Acknowledgements

The author wishes to express his sincere thanks to Prof. N. A. Erady who has been the source of all help all through his work. The author's thanks are also due to Rev. Fr. Dr. H. Santapau who rendered the diagnosis of the new species into Latin.

A Catalogue of the Birds in the Collection of the Bombay Natural History Society—5

Gruidae, Rallidae, Heliornithidae, Otididae, Jacanidae, Haematopodidae, and Charadriidae (Charadriinae)

BY

HUMAYUN ABDULALI

[*Continued from Vol.* **66** (2) : 285]

320 **Grus grus lilfordi** Sharpe (Jhelum River, near Jelalpur, Punjab) Common Crane **6** : 50

nil.

Though I have been unable to trace the reference, it may be worth keeping in mind that Christison (*JBNHS* **43** : 485) refers to the typical race being recorded by Ticehurst as a passage migrant over Quetta, Kalat, and Mekran.

321 **Grus nigricollis** Przevalski (Koko-nor) Blacknecked Crane **6** : 52

nil.

322 **Grus monacha** Temminck (Hokkaido and Korea) Hooded Crane **6** : 51

nil.

323 **Grus antigone antigone** (Linnaeus) (Farther India) Sarus Crane **6** : 55

4 : 1 ♀ juvenile, 2 o ? 1 chick*

1 Dharamsala, Punjab ; 1 Bhavnagar* ; 2 Kheri District, Oudh.

324 **Grus antigone sharpii** Blanford (Burma) Burmese Sarus **6** : 56

nil.

325 **Grus leucogeranus** Pallas (Swamps bordering the Ischim, Irtych, and Ob Rivers) Siberian or Great White Crane **6** : 53

1 ♂ Victoria Gardens, Bombay.

This was listed as a White Stork (*Ciconia ciconia*).

326 **Anthropoides virgo** (Linnaeus) (India) Demoiselle Crane **6** : 57

3 : 1 ♂ 1 ♀ 1 o ?

1 *Mosul* (in captivity) ; 1 Bhavnagar, Gujerat ; 1 Baghowni, Darbhanga, Bihar.

All three are poor specimens.

327 **Rallus aquaticus korejewi** Zarudny (Northeastern Turkestan, Buchara, Transcaspia, and east Persia) Water Rail **6** : 6

328 **Rallus aquaticus indicus** Blyth (Lower Bengal and India generally) **6** : 4

11 : 2 ♂♂ 2 ♀♀ 7 o ?

1 *Bait-al-Khalifa, Samara, left bank of R. Tigris, Mesopotamia* ; 1 *Bander-i-Gaz, W. Astrabad,* 1 *Pir-i-Banu, Shiraz, Iran* ; 1 Pishin, Baluchistan ; 1 Miranshah, N.W.F.P. ; 2 Jajjah, Abbasein, Bahawalpur, 1 Beas River, Punjab ; 1 Jhansi, U.P. ; 1 *Kashgar,* 1 *Tientsin, China.*

10 of the 11 specimens, from Bahawalpur, Punjab, N.W.F.P., Jhansi, etc. (including two from Bahawalpur marked *korejewi* by Whistler) do not show any differences which would permit their separation into two races. The grey underparts of *korejewi* as in IND. HANDBOOK (**2,** Plate 25) are paler than in the Bahawalpur birds referred to.

The single bird (No. 13852) from Tientsin, China,* has a larger wing 130 cf. 114-125, whitish underparts with no grey, and an almost black head. The wing coverts also show a more prominent barring, which is absent in most but exists to a smaller extent in some of the others.

	Wing	Tail
2 ♂♂	122 (2) (120-130)	53 (2) (52-65)
2 ♀♀	110, 120 (110-122)	48, 51
6 o ?	114-125 av. 119·6	47-50 av. 49
1* o ?	130	47

329 **Rallus striatus albiventer** Swainson (India) Bluebreasted Banded Rail **6** : 7

9 : 1 ♂ 3 ♀♀ 5 o ? (1 juvenile, Karwar)

1 Powai, Bombay ; 2 Karwar, N. Kanara ; 1 Madurantakam, Chingleput, Madras ; 1 Adampur, U.P. ; 2 Shillong, 1 Dibrugarh, Assam ; 1 *Taungyi, Burma.*

The small number of specimens, including very old ones, does not permit any conclusions, but some of the adults have their heads paler rufous than the others. The bird from Chingleput District (collected on 5 March 1899), overlooked by Whistler, appears to be the only definite record from eastern peninsular India.

330 **Rallus striatus obscurior** (Hume) (Andaman Islands) **6** : 9

1 o ? Andamans.

330a **Rallus striatus nicobarensis** Abdulali (Nancowry, Central Nicobars)

1 ♂ Nancowry, Central Nicobars, Type.

331 **Rallina fasciata** (Raffles) (Benkulen, Western Sumatra) Redlegged Banded Crake **6** : 17

nil.

332 **Rallina eurizonoides amauroptera** (Jerdon) (Northern India) Banded Crake **6** : 16

5 : 3 ♂♂ 1 ♀ 1 o?

1 Bandra, Bombay; 1 Khandala (off nest); 1 Karwar, N. Kanara; 1 Honametti, Mysore; 1 Peermade, Kerala.

	Wing	Tail
♂♂	127, 130, 130 (♂♀ 122-132)	54, 55, 57 (♂♀ 55-64)
♀	125	55

The older skins show a rufous tinge on the upper parts.

Though said to be generally distributed throughout the wetter and well-wooded portions of India, I can find no records very far away from the line of Ghats from Bombay southwards. Bell (*JBNHS* **14** : 395) did not see them in Kanara between December and April, which confirms the statement that it is a winter visitor to Ceylon (AV. CEYLON p. 261).

333 **Rallina canningi** (Blyth) (Andaman Islands) Andaman Banded Crake **6** : 18

2 o? marked 'died in captivity' but collected by R. C. Temple.

Wing 156, 159 (151-163); tail 84, 87 (73-92); tarsus 51, 52 (56-62)

This bird, restricted to the Andamans, was named after Lord Canning, then Governor-General. Somebody, in error, said the type locality was 'Port Canning' (which is in Bengal!) and this has been quoted from author to author and is repeated in IND. HANDBOOK (**2** : 157).

334 **Crex crex** (Linnaeus) (Sweden) Corn Crake **6** : 10

7 : 2 ♂♂ 1 ♀ 4 o?

2 *Shaiba, Arabia*; 1 *Khor Abdulla, Persian Gulf*; 2 *Felujah*, 1 *Sulaimaniah*, 1 *Zubra R.*, 1400′, *Mesopotamia*.

	Wing	Tail	Tarsus
♂♂	135, 145 (135-150)	46, 50 (40-50)	37, 41 (34-43)
♀	137 (130-145)	46	39
o?	126, 129, 138, 139	47 (2), 50 (2)	35, 36, 39, 40

Three birds obtained in April, May, and June are in summer plumage, with greyish underparts, which are darker in the male.

335 **Porzana parva** (Scopoli) (probably Carniola) Little Crake **6** : 13

7 : 3 ♂♂ (1 by plumage) 4 ♀♀

1 *Basra*, 1 *Felujah, Euphrates*, 1 *Tigris*, 1 *Sheikh Saad, Mesopotamia*; 1 Pithoro, Sind; 1 Bombay, 1 Karwar, N. Kanara.

	Wing	Tail
♂♂	101, 104, 106 (102-110)	48, 54, 57 (50-57)
♀♀	97, 97, 99, 100 (95-106)	49, 51, 52, 52

[336 **Porzana parva illustris** Gavrilenko (Tarim River, Turkestan) is dropped in IND. HANDBOOK].

337 **Porzana pusilla pusilla** (Pallas) (Dauria) Eastern Baillon's Crake **6** : 14

20 : 13 ♂♂ (7 ad.) 4 ♀♀ (2 ad.) 3 o ?

2 *Rohtak River, near Sib* 3630′, *Persian Baluchistan ;* 1 Jajjah, Abbasein, 250′, 1 Keishopur Jheel, Gurdaspur, 4 Simla Hills, 1 Jagadhri, Ambala ; 1 Bulsar, Gujerat ; 2 Wada, 1 Diva, 1 Mumbra, Thana ; 1 Dharamtar, Kolaba ; 1 Chiplun, Ratnagiri ; 1 Karwar ; 1 Bakri, Monghyr, 1 Rajputtee, Chupra, Bihar ; 1 *Peking, China.*

	Wing	Tail	Bill
Ad. ♂♂	89-96 av.91 (♂♀ 84-91)	42-47 av.44·5 (♂♀ 40-46)	15-16 (♂♀ 14-16)
Ad. ♀♀	91, 92	42, 46	15, 15

It will be noticed that though there is no difference in wing-size between the sexes the measurements are slightly larger than in IND. HANDBOOK (**2** : 162) rendering the key on page 159 ineffective with regard to the separation of this species from *P. parva* by wing alone.

338 **Porzana porzana** (Linnaeus) (France) Spotted Crake **6** : 11

21 : 7 ♂♂ 6 ♀♀ 8 o ?

1 *Amara,* 1 *Baghdad,* 1 *Shaiba,* 1 *Sheikh Saad, Iraq ;* 1 *Shiraz,* 1 *Khor Musa, Persia ;* 1 N.W.F.P. ; 1 Lahore, 1 Punjab ; 1 Kutch ; 1 Nasik, 2 Ambarnath, Kalyan, 2 Bombay, 2 Panvel, Kolaba ; 1 Chupra, 2 Calcutta Market ; 1 Meerut.

	Wing		
♂♂	115-125	av. 119	(♂♀ 112-119)
♀♀	110-116	av. 112·5	

The males have slightly larger wings than the females.

339 **Amaurornis fuscus bakeri** (Hartert) (Bhim Tal, Kumaon) Northern Ruddy Crake **6** : 21

4 : 2 ♂♂ 1 ♀ 1 o ?

2 Ambala District, Punjab ; 1 Kashmir ; 1 *Maymyo, Upper Burma.*

Wing 98 (♀) 103, 104, 105 (97-110 ; 105-109 Whistler in IH)

Excluding the female from Burma, the others from northern India have their heads and underparts more vinous, less chestnut, than *zeylonicus* from southern India. The statement in FAUNA (**6** : 21) that it is slightly paler than *zeylonicus* appears to be a slip.

Donahue (*JBNHS* **64** : 414) recorded specimens collected as far south as Delhi. I have had the opportunity of examining the specimens (kindly lent by the Michigan State University Museum) and, while confirming the racial identification, would note that they include two in juvenile plumage, both collected on 1 June 1962, leaving little doubt that they are resident in this area.

340 **Amaurornis fuscus zeylonicus** Baker[1] (Ceylon) Southern Ruddy Crake **6** : 20

3 ♂♂ (1 juv.)

1 Thana, 1 Powai, Bombay ; 1 Karwar, North Kanara.

Wing 96, 97 (♂♀ 87-97, once 99. IH 90-98)

[1]The author's name is erroneously placed in brackets in IND. HANDBOOK.

The immature bird from Thana, near Bombay (1st November 1953) is dusky brown above, and lacks the olive-green tinge of the adult. The chin and throat are white and the rest of the underparts dusky brown, with irregular traces of white, but not 'dull white barred with dusky brown' as stated in IND. HANDBOOK. The undertail coverts are darker and bear some of the white barring of the adult.

In addition to their smaller size and paler underparts, the three adults available differ from *bakeri* in the lower belly, being barred with white.

341 **Amaurornis bicolor** (Walden) (Rungbee, Darjeeling) Elwes's Crake **6** : 26

nil.

342 **Amaurornis akool akool** (Sykes) (Dukhun) Brown Crake **6** : 25

4 : 1 ♂ 3 ♀♀

1 Chandigarh, 1 Jagadhri, Ambala, Punjab; 1 Gwalior, C.I.; 1 Begumabad, Meerut, U.P.

Wing 122, 122, 125, 126 (♂♀ 114-131)

343 **Amaurornis phoenicurus chinensis** (Boddaert) (China, restricted to Hong Kong) Whitebreasted Waterhen **6** : 24

10 : 4 ♂♂ 3 ♀♀ 3 o ? (1 chick*)

1 Ambala, Punjab; 1 Baghowni, Tirhut, 1 Darbhanga*, Bihar; 1 Berbera, Orissa; 1 Calcutta Market; 1 Goalpara, 1 Manipur, Assam; 1 *Maymyo*, 1 *Prome*, 1 *North Shan States.*

344 **Amaurornis phoenicurus phoenicurus** (Pennant) (Ceylon) White-breasted Waterhen **6** : 23

11 : 4 ♂♂ 2 ♀♀ 5 o ? (4* chicks)

1 Ambarnath, Kalyan; 6* Bombay; 1 Panvel, Kolaba; 1 Ratnagiri; 1 Dushi, Karwar; 1 Udipi, Mysore.

It is difficult to recognise two races in India, but I have followed IND. HANDBOOK in dividing them into a northern (and Burmese) form separated from the southern birds by the 20th parallel. The latter are smaller but include large individuals. A comparison with topotypical material from Hong Kong and Ceylon may be profitable.

Their wings measure:

	♂♂	♀♀	o ?
Northern birds	153, 169, 173, 177	151, 153, 160	160, 161
	(152-178)	(149-168)	
Southern birds	155, 163, 164, 171	153, 155	156

Some birds appear to have heavier and yellower beaks, but it is not possible to link this with sex or season.

345 **Amaurornis phoenicurus insularis** Sharpe (Andamans) White-breasted Waterhen **6** : 25

1 ♂ Wrightmyo, South Andamans.

345a **Amaurornis phoenicurus leucocephala** Abdulali (Car Nicobar)

(a) 5 : 4 ♂♂ 1 ♀ * Car Nicobar. * Type
(b) 4 : 2 ♂♂ 2 ♀♀ 2 Camorta, 2 Nancowry, Central Nicobars.

In *JBNHS* **64** : 159 I have suggested that (b) may be separable, but have not had the opportunity of examining more material.

346 **Gallicrex cinerea cinerea** (Gmelin) (China) Water Cock **6** : 29

12 : 1 ♂ 8 ♀♀ 3 o ? (1 in dark breeding plumage*)
6* Bombay ; 1 Chezwad, 1 Karwar, 1 Sanvordan, North Kanara ; 1 Dibrugarh, Assam ; 1 Bambooflats, South Andamans ; 1 no locality.

There appears to be an inordinately large proportion of females, but by measurement all the three unsexed specimens are males, and two others Nos. 13920 and 13921, also by measurement, appear to be wrongly sexed.

347 **Gallinula chloropus indica** Blyth (Calcutta) Indian Moorhen **6** : 28

17 : 6 ♂♂ (3 juv.) 10 ♀♀ (4 juv.) 1 o ?
1 *Shaiba, Arabia* ; 1 *Sulaimaniyah, Iraq* ; 2 *Persian Gulf* ; 1 Simla ; 1 Ratlam, C.I. ; 1 Powai, Salsette, 3 Thana, 2 Panvel, 1 Ratnagiri ; 1 Monghyr, 1 Sarun, Bihar ; 1 Calcutta Market ; 1 *Peking, China.*

The birds in adult plumage are no larger than those in juvenile, and the sexes show little difference in wing size.

5 (3 ad. 2 juv.) ♂♂	161-170 av. 165
10 (6 ad. 4 juv.) ♀♀	152-172 (2) av. 162

(152-172 ; Vaurie : Eastern ♂♂ 160-182 av. 169·7, ♀♀ 156-174 av. 162·5 ;
Western ♂♂ 160-190 av. 178·3, ♀♀ 158-180 av. 169.5.)

Both the largest and the smallest females are from the Persian Gulf and Iraq, in juvenile plumage !

In the original description, Blyth (Calcutta) (1842) says : ' Common enough in vicinity of Calcutta—appears, judging from memory, to be constantly inferior in size to the British species. As in the latter, the female is larger and much finer coloured than the male.' He gives no measurements. The following year he described *parvifrons* (*JASB* **12** : 180) from India as inferior in size and with a much less developed frontal shield, and added that Jerdon had informed him that true *chloropus* in addition to this small form had been obtained in southern India. Jerdon (B. OF INDIA **3** : 718) ignores this separation, but refers to the females being ' larger and somewhat richer coloured than the male '. Blanford (**4** : 176) states : ' Females run smaller. Indian birds are smaller than European ' but retains the name *chloropus*, omitting *indica*, even in the synonymy/list of references.

Vaurie (1965, BIRDS OF PAL. FAUNA, NON-PASSERIFORMES) gives details of a long series of measurements and though he agrees that populations from the east average smaller than those from the west, he draws attention to the fact that the individual measurements overlap in over two-thirds of the whole number and subspecific recognition is not warranted.

This bird has been noted as migratory and a passage migrant in parts of northern India, while it is also believed to be resident further south, e.g. around Bombay. It is possible that a comparison of definitely known resident and/or migrant populations may permit a clarification.

347a **Gallinula chloropus orientalis** Horsfield (Java)

3 : 2 ♂♂ 1 o ? All near Port Blair, South Andaman, in March. Wings 165, 166, 170.

The unsexed bird with a red bill and a broad and prominent shield on the forehead was identified *orientalis* by Dr. Ripley. The two others have the bill and shield dark and cannot be separated from Indian birds.

348 **Porphyrio porphyrio seistanicus** Zarudny & Härms (Seistan)

2 : 1 ♀ 1 o ?
1 *Amara*, 1 *north of Basra, Mesopotamia.*
♀ wing 256 ; bill from feathers 70 ; tarsus 89.

The unsexed bird has clipped wings but its 74 mm. bill, 101 mm. tarsus and 103 mm. mid-toe without claw, are longer than in any of others available from Indian limits. IND. HANDBOOK (**2** : 178) refers to this race as the Baluchi Purple Moorhen, but adds that birds from *c.* south of Chagai, Northwestern Baluchistan, are closer to the Indian *poliocephalus*. None of the northern specimens (listed below) appear to be separable in size or colour from those from peninsular India, and I wonder if this race is worth retaining in the Indian list.

349 **Porphyrio porphyrio poliocephalus** (Latham) (India) Purple Moorhen **6** : 32

14 : 5 ♂♂ 5 ♀♀ 4 o ? (1 chick)
2 Kalat, Baluchistan ; 1 Chitral ; 1 Pithoro, 2 Dadu, Larkana, Sind ; 3 Nandur-Madhmeshwar, 1 Ghoti, Nasik ; 1 Kurla, Bombay, 1 Panvel, Kolaba, 1 Kolhapur, Maharashtra ; 1 Calcutta Market.

	Wing	Bill	Tarsus	Mid-toe without claw
♂♂	253, 254, 260	65, 69, 71	91, 94, 94	93, 97, 97
♀♀	244-253 av.250·6	59-67 av.62·5	88-91 av.90	89-97 av.93

EL **Porphyrio porphyrio viridis** Begbie (Sumatra)

1 ♂ *Sumatra.* Wing 227 ; tarsus 89 ; mid-toe without claw 86.

350 **Fulica atra atra** Linnaeus (Sweden) Coot **6** : 34

21 : 3♂♂ 13 ♀♀ 5 o ? (3 largely albinoid*)
2 *Persian Gulf*; 2 Chitral; 1 Thar Parkar*, 1 Larkana*, 1 ? Sind ; 1 Kutch ; 3 Ghoti*, Nasik, 1 Bombay, 1 Bassein ; 2 Panvel, Kolaba ; 1 Shimoga, Mysore ; 1 Nellore, A.P. ; 1 Samastipur, Bihar ; 1 Calcutta Market ; 2 *Peking, China.*

Two birds, from Peking (♂ 214) and Chitral (♀ 213) have the largest wings while the southern-west females from Shimoga, Mysore (195) and

Nellore, A.P. (200) are the smallest (♂♀ 185-220). The last two have their bills (without shield) 31 and 34 which is also smaller than in the other females 35-40 av. 37·6 (culmen 33-38). Is it possible that the resident birds are smaller than the migrants ?

351 **Heliopais personata** (G. R. Gray) (Malacca) Masked Finfoot **6** : 36

5 : 2 ♂♂ 1 ♀ 2 o ?

2 Tingri River, 1 Moran, Dibrugarh ; 1 *Arakan Yoma*, 1 *Mayangmyo, Irawaddy Delta.*

	Wing	Tail	Bill
♂♂	244, 251 (248-253)	124, 126 (98-124)	56, 57 (52-56)
♀	239 (232-241)	117 (as above)	52 (41-50)

Unsexed specimen No. 13951 from Moran has one wing 253 mm. (other 246), but it lacks the black chin of the adult male and has a black forehead as in the female. It lacks completely the traces of barring on the lower belly and undertail coverts visible in all the others.

352 **Otis tarda dybowskii** Taczanowski (Lauria) Great Bustard **6** : 60

3 : 1 ♀* 2 o ? (1 in very poor condition)

1 *Qizil Robot, Mesopotamia* ; 1 Chitral ; 1 Jacobabad, Sind.

The wings 463, 470*, 463 (♂♂ 495-635 ; ♀♀ 455-495) appear to indicate that they are all females.

The collection also includes remnants of specimens collected at Mardan, N.W.F.P., in 1911, and Kashgar, Chinese Turkestan, in May 1947.

353 **Otis tetrax orientalis** Hartert (Sarepta, Southern Russia) Eastern Little Bustard **6** : 62

3 : 1 ♂* 2 o ?

1 *Sulaimaniyah, Iraq* ; 1 Sind ; 1 Kashmir.

Wings 240, 245, 260*

These three were marked juveniles, while eight immature specimens of the Houbara (*Chlamydotis u. macqueenii*) were listed as adults of this species ! Emarginations as on the fourth primary are visible on the third primary also.

354 **Choriotis nigriceps** (Vigors) (Foothills of NW. India) Great Indian Bustard **6** : 64

6 : 3 ♂♂ 3 ♀♀ (except for one male, the others have been separated by size and plumage)

5 Chackro, 1 Thar & Parkar, Sind.

All the birds were collected in the same district in November/December 1910 when N. B. Kinnear, then the Society's Curator, was visiting Sind. The birds fall into two distinct size groups which I am accepting as ♂ and ♀. The females are further distinguished by having their upper parts more coarsely vermiculated.

In IND. HANDBOOK (**2** : 191) reference is made to 961 Great Indian Bustards being shot in the neighbourhood of Ahmednagar in the Deccan between 1809 and 1829. Sir Walter Elliot (*P.Z.S.* 1880, p. 486) referring no doubt to the same sportsman (Capt. Robert Mansfield) states that a few years later the 1000 mark was passed. In the same note Elliot refers to hearing a sound as of a man in pain and riding for ' upwards of a mile ' before he saw a large cock strutting about and calling, and being approached by several hens. Other notes on food, flight etc., are included.

	Wing	Bill	Tail	Tarsus
♂♂	595, 643, 645	58, 76	233, 270, 292	191, 191, 201
	(614-762)	(85-95)	———	(*c*. 190-208)
♀♀	517, 520, 537	58, 62, 63	223, 235, 236	164, 165, 171
	(450-540)			(162 IH **2** : 190)

355 **Chlamydotis undulata macqueenii** (J. E. Gray) (Foothills of NW. India) Houbara Bustard **6** : 67

13 : 3 ♂♂ 4 ♀♀ 6 o ?

1 *Mesopotamia* ; 1 *Persia* ; 1 Panjgur, Baluchistan ; 4 Thar & Parkar, 4 Sind ; 1 Suratgarh, Bikanir ; 1 (No. 20976) ?.

Eight of the specimens, in immature plumage and listed as *Otis tetrax* (!), have not yet fully acquired the plumes, nor the white, on the head. They are also a little smaller than those in adult plumage.

	Wing	Bill	Tail	Tarsus
3 immature ♂♂	336, 355, 360	33, 36	178, 203, 208	83, 86, 98
	(363-411)	(34-38)	(216-241)	(about 125)
2 immature ♀♀	335, 336	40	176, 192	87, 91
2 adult ♀♀	401	42	205, 228	90, 97
	(342-381)	(30-34)		
4 adult o ?	365, 381, 392, 423	37, 38(2), 39	188, 203, 228	92, 96, 98, 104.

356 **Eupodotis bengalensis bengalensis** (Gmelin) (Bengal) Bengal Florican **6** : 71

9 : 6 ♂♂ (one by plumage) 3 ♀♀

8 Goalpara, 1 Kilahari Block, Assam.

	Wing	Tail	Bill	Tarsus
5 ♂♂	300-355 av.327	150-161 av.157	36-39 av.38	135-143 av.138
	(338-347)	(165-184 ; IH ♂♀ *c*. 190)	(30·5-32)	(126-131 ; IH *c*. 165)
3 ♀♀	332, 340, 350	146, 155, 165	39, 40, 41	143, 150 (2)
	(338-368)		(38-39)	

IND. HANDBOOK (**2** : 195) errs in quoting combined measurements for the male and female as from the FAUNA ; in the FAUNA the measurements are separately shown, only the description of the young male being included with that of the female, which is said to be larger.

357 **Sypheotides indica** (J. F. Miller) (India) Likh or Lesser Florican **6** : 69

5 : 3 ♂♂ 2 ♀♀

3 Gwalior, C.I. ; 1 Bombay ; 1 Belikeri (?) Kanara.

	Wing	Tail	Bill	Tarsus
♂♂	173, 190 (2)	86, 90, 90	36, 37	92, 92, 95
	(180-204)	(♂♀ 82, 90, 90)	(31-38)	(85-95)
♀♀	224, 226	111, 112	40, 40	—
	(209-248)		(37-42)	

The female is appreciably larger than the male.

358 **Hydrophasianus chirurgus** (Scopoli) (Luzon) Pheasant-tailed Jaçana **6** : 41

23 : 12 ♂♂ 6 ♀♀ 5 o ? (10 in breeding plumage)

1 Jagadhri, Ambala ; 1 Wular, Kashmir ; 1 Jacobabad, Sind ; 1 Dholpur, Rajasthan ; 1 Bunderkhand, C.I. ; 1 Powai, 2 Malad, Bombay, 2 Thana, 1 Madhmeshwar, Nasik, 1 Gondia, Bhandara ; 1 Kollengode, Malabar ; 3 Palni, Madura District ; 1 Meerut, U.P. ; 2 Baghowni, Darbhanga, 1 Bakhri, Monghyr, 2 Calcutta Market ; 1 *Maymyo, Burma.*

Birds in breeding plumage have been taken between 20 May and 20 September.

As in other jaçanas, the females are larger. Excluding No. 20189 from Dholpur, with a 236 mm. wing and marked ♂, the males have their wings 175-202 av. 188, and the females 186-225 av. 206 (♂♀ 182-242).

359 **Metopidius indicus** (Latham) (India) Bronze-winged Jaçana **6** : 39

16 : 7 ♂♂ 6 ♀♀ 3 juveniles

1 Daman Road, Gujerat ; 1 Powai, 2 Thana, 6 Panvel ; 1 Baghowni, 1 Tirhut, Darbhanga District ; 1 Calcutta Market, 1 Kishanganj, Bengal ; 2 *Upper Burma.*

The measurements in the FAUNA (♂♂ 145-198, ♀♀ 152-186) do not indicate any appreciable difference in size between the sexes, but in the present series the 3 adult males have their wings 150-162 av. 154 (IH 153-177) against 170-183 av. 176·6 (IH 170-184) in the females. In four birds seized under the Bombay Wild Animals and Wild Birds Protection Act 1951 on the same day, the largest (wing 175) is marked male and the smallest (150) female, but this is possibly due to a mix-up in the labels.

360 **Haematopus ostralegus ostralegus** Linnaeus (Europe and America=Oland) Oystercatcher **6** : 165

6 : 3 ♂♂ 3 o ?

1 *Amara,* 1 *Basra, Mesopotamia* ; 3 Panvel (purchased), 1 Alibag, Kolaba District.

Wing 239-265 av. 248 (240-261).

Only No. 14375 (wing 365) from Amara, Mesopotamia, has black upper parts.

361 **Haematopus ostralegus osculans** Swinhoe (North China) **6** : 166

nil.

362 **Vanellus leucurus** (Lichtenstein) (Between the Kuwan and Jan Darya, Turkestan) White-tailed Lapwing **6** : 183

17 : 10 ♂♂ 4 ♀♀ 3 o ? (2 imm. with all-white underparts)

1 *Abu Rahan, near Qurna*, 1 *Hindia Barrage*, 1 *Iskandaryeh, Euphrates, Iraq* ; 1 *Frontier of Arabistan*, 1 *Kuh-i-Khawaja Mt., Hamun Lake*, 1 *Shiraz, Iran* ; 2 *Rhotak R., near Sib, Persian Baluchistan* ; 1 Quetta, Baluchistan, 1 Bahawalpur State, 1 Jagadhri, Punjab ; 1 Dadu, Larkana, Sind ; 1 Saiat, 1 Pareiej, Kaira District ; 1 Muradnagar, Meerut, U.P. ; 1 Baghowni, Darbhanga, Bihar ; 1 Calcutta Market.

The wings measure :

10 ♂♂ 172-182 av.178 4 ♀♀ 175, 180, 180, 184
(♂♀ 169-178 ; IH ♂♂ 173-189, ♀♀ 167-186)

Two immature birds from Rhotak R(iver ?) and Quetta have no ashy grey on the underparts, which are mostly white. The upper parts are as in the adults, except that the wing coverts and a few of the feathers of the back are tipped with brown.

363 **Vanellus gregarius** (Pallas) (Volga, Jaiku, and Samara) Sociable Lapwing **6** : 182

14 : 5 ♂♂ 8 ♀♀ 1 o ? 4 in breeding plumage, 5 juv. with prominently marked upper breasts.

2 *Tel-el-Lahm, Euphrates*, 1 *Ezra's Tomb, Mesopotamia* ; 1 4700′, 1 6000′, Chitral ; 1 Darazpur, Ambala, Punjab ; 1 Dalpaka, Hyderabad, 1 Pithoro, Sind ; 2 Esplanade, Bombay City ; 2 Karkode, Meerut, U.P. ; 1 Bunar, Bengal?, *col.* C. Primrose, January 1915 ; 1 Baghowni, Tirhut, Bihar.

Of a male and female taken in Chitral on 23 and 17 March, the latter has no black on the underparts where the feathers are smoky brown tipped with rufous.

5 ♂♂ 197-205 av. 201·6 (♂♀ 196-204 ; IH ex BR. HANDBOOK 198-211)
8 ♀♀ 200-207 av. 204 (IH 199-212).

The measurements of the wings of the specimens available agree with those in the FAUNA, and are slightly less than those indicated in BR. HANDBOOK.

364 **Vanellus vanellus** (Linnaeus) (Sweden) Peewit or Lapwing **6** : 180

14 : 7 ♂♂ 4 ♀♀ 3 o ?

1 *Tigris*, 2 *Sulaimaniyah*, 1 *Sumara, Mesopotamia* ; 1 *Persian Gulf* ; 2 *Gusht, 42 m. north-west of Dizak, Persian Baluchistan* ; 1 Chitral, N. W. F. P. ; 1 Turbat, Kalat, Baluchistan ; 1 Rawalpindi, Punjab ; 1 Chupra, Saran, Bihar ; 1 Bengal ; 1 Dibrugarh, Assam ; 1 *Peking, China*.

Wing

7 ♂♂ 219-231 av. 227.5 (♂♀ 220-236 IH ex Hartert)
4 ♀♀ 224, 226, 231 (2).

All the specimens were collected between October and March and, except for female No. 14472 dated 15 November 1916, are in non-breeding plumage.

365 **Vanellus cinereus** (Blyth) (Calcutta) Grey-headed Lapwing **6** : 191

2 ♀♀ : 1 Calcutta Market ; 1 *Summer Palace, Peking.*
Wing 250, 252 (228-255) ; bill 37(2) (35-39) ; tarsus 74, 77 (75-79) ; tail 110, 111 (93-112).

EL **Vanellus indicus aigneri** (Laubmann) (Sonmiani, Mekran) **6** : 188

1 ♀ *Sheikh Saad, Iraq*
Wing 224 ; tail 116 ; tarsus 67.

IND. HANDBOOK (**2** : 212) follows the SYNOPSIS in synonymizing this with the nominate race. The present specimen is noticeably paler than the others, and though no material from Sind is available, it is possible that this is a good race and will be found within our limit west of the Indus (vide Vaurie, 1965, p. 390).

366 **Vanellus indicus indicus** (Boddaert) (Goa) Red-wattled Lapwing **6** : 186

17 : 8 ♂♂ 8 ♀♀ 1 o ? (1 chick*, 1 pullet)
1 Simla ; 1 Patna, Jaipur, Rajasthan ; 1 Kharirohar, Kutch ; 1 Gir Forest, Amreli, 1 Nadiad, 1 Dabka, 1 Baroda ; 1 Vasind, Thal Ghat, 2 Bhyander and Bassein, Bombay ; 1 Belapur, Thana ; 1 Dharamtar Creek, 1 Koyna Valley, Kolaba ; 1 Golapalli, Bastar ; 1 Shahjehanpur, Oudh ; 1 Bonzini, Nepal ; 1 Goalpara, Assam.

	Wing	Tail
♂♂	218-235 av. 225	109-126 av. 118
♀♀	208-225 av. 218	109-119 av. 116
	(♂♀ 212-233)	(♂♀ 107-116)

The two largest males with wings 235 and 230 are from Nepal and Kheri District, Oudh.

367 **Vanellus indicus lankae** (Koelz) (Galgamuwa, Ceylon) Ceylon Red-wattled Lapwing

nil.

368 **Vanellus indicus atronuchalis** (Jerdon) (Burma) **6** : 189

1 ♂ *Toungyo, Burma.* Wing 218, tail 115.

369 **Vanellus spinosus duvaucelii** (Lesson) (Calcutta) Spur-winged Lapwing **6** : 184

13 : 5 ♂♂ 7 ♀♀ 1 o ?
1 Samol, Talcher, Orissa ; 1 Patharghatta ; 1 Baghowni, Darbhanga, Bihar ; 2 Bhimtal, Kumaon, 1 Nahrosa, Pilibhit, 1 Ganges, Cawnpore, U.P. ; 2 Teesta River, Sikkim ; 3 *Chindwin*, 1 *Henzada, Burma.*
Wing ♂♂ 196-203 av. 198 ♀♀ 191-200 av. 196 (185-205)
Tail ♂♂ 88-95 av. 90·5 ♀♀ 88-92 av. 90 (88-94)

370 **Vanellus malabaricus** (Boddaert) (Malabar Coast) Yellow-wattled Lapwing **6** : 190

21 : 10 ♂♂ 8 ♀♀ 2 o ? 1 pullet*
1 Sind ; 2 Kharirohar, Kutch ; 1 Cambay, 2 Jambughoda ; 1 Dodi, Malwa, Bhopal, C.I. ; 1 Balaghat, M.P. ; 1 Santa Cruz, Bombay ; 2 Rewdanda, Kolaba,

1 Panchgani, Satara ; 1 Sagar, Mysore ; 1 Jamestown, Kanyakumari* ; 1 Palkonda Hills, South Cuddapah, 1 Rapur, Nellore ; 1 Barkul, Chilka Lake, Orissa ; 1 Baghowni, Tirhut, Bihar ; 1 Meerut, 1 Kanpur, 1 Lalkua, foot of Kumaon Hills, U.P.

	Wing	Tail
10 ♂♂	194-209 av. 201·8	76-88 av. 82
7 ♀♀	193-201 av. 197	77-83 av. 80
	(♂♀ 184-202	80-89)

The males are slightly larger than the females.

From the material available, it would appear that the black head and the black chin is a seasonal character acquired by both sexes from about January (earliest 27 December, Kanpur) to August (6 August, Palkonda Hills). A juvenile (No. 23236) with its bill and wing not fully grown, has patches of black on the head, while adults of both sexes from Kutch and Gujerat obtained in November have no traces on the head or chin.

371 **Pluvialis squatarola** (Linnaeus) (Sweden) Grey Plover **6** : 156

5 : 4 ♂♂ 1 o ? (1* ♂ in breeding plumage, 10th May, 1940)

1 *Tanb Island, Persian Gulf* ; 1* Kandla, Kutch ; 1 Bombay, 1 Rewas, Kolaba ; 1 Calcutta Market.

	Wing	Tail	Bill	Tarsus
♂♂	195, 201, 202, 203	72, 79(3)	29, 31(2), 32	46, 47(2), 51
	(182-202)	(69-82)	(27-32)	(43-50)

372 **Pluvialis apricaria apricaria** (Linnaeus) (Lapland) Golden Plover **6** : 176

1 ♀ Karachi, Sind, on 7th January 1919.
Wing 184 ; tail 69 ; bill 23 ; tarsus 39.

373 **Pluvialis dominica fulva** (Gmelin) (Tahiti) Eastern Golden Plover **6** : 178

28 : 13 ♂♂ 9 ♀♀ 6 o ?

1 Mandir, Kutch ; 6 Bombay ; 1 Rewas, Kolaba ; 1 Karwar, N. Kanara ; 2 Barkul, Chilka Lake ; 1 Manjhaul, 1 Benua, 2 Baghowni, Darbhanga, Bihar ; 1 Calcutta Market ; 1 Goalpara, Assam ; 3 S. Andamans, 5 Car Nicobar, 1 Camorta, Central Nicobars ; 1 *S. Shan States,* 1 *Prome, Burma.*

	Wing	Bill	Tail
13 ♂♂	158-174 av. 164·5	22-26 av. 24	57-63 av. 59
	(165-174)	(21-27)	(59-64)
9 ♀♀	160-173 av. 163·7	20-27 av. 23	55-61 av. 57·4
	(158-175)	(22-26)	—

374 **Charadrius leschenaultii** Lesson (Pondicherry, India) Large Sand Plover **6** : 175

22 : 9 ♂♂ 12 ♀♀ 1 o ?

1 *Tanb Island,* 2 *Persian Gulf* ; 3 Kandla, Kutch ; 1 Pirotan Is., 1 Chad, Gulf of Kutch ; 4 Salsette, Bombay ; 4 Rewas, Alibag, Kolaba ; 1 Calcutta Market ; 1 Chauldhari, 1 Port Blair, S. Andamans ; 2 Camorta, 1 Trinkut, Central Nicobars.

Four of these specimens were listed under *mongolus,* from which (at least, from *atrifrons* the only race accepted in Indian limits) they can be separated by their larger wing and bill.

	Wing	Bill
6 ♂♂	136-148 av. 142	23-25 av. 24·1
12 ♀♀	135-150 av. 144·7	24-25 av. 24·4
	(♂♀ 134-150)	

375 **Charadrius melanops** Vieillot (New South Wales) Australian Blackfronted Plover

nil.

376 **Charadrius asiaticus asiaticus** Pallas (Salt lakes of the South Tartar Steppes) Caspian Sand Plover **6** : 158

4 : 2 ♂♂ 2 o ? *Sheik Saad* 20 *m. north-west of Kut on Tigris, Mesopotamia.*

	♂♂	o ?
Wing	143, 157 (141-155)	152, 152 (♀ 140-150)
Bill	18, 22 (19-23)	18, 20 (♀ 20-23)
Tail	48, 56 (49-60)	57, 58

The key in IND. HANDBOOK (**2** : 228) separates this race from *veredus* by a wing under 152 mm. and then quotes measurements allowing one up to 155.

A female of *Charadrius leschenaultii* from the Persian Gulf with a little rufous on the underparts was included with this species.

377 **Charadrius asiaticus veredus** Gould (Northern Australia) **6** : 159

nil.

378 **Charadrius hiaticula tundrae** (Lowe) (Valley of the Yenessei)

nil. **6** : 168

379 **Charadrius dubius curonicus** Gmelin (Kurland) European Little Ringed Plover.

43 : 14 ♂♂ 24 ♀♀ 5 o ? (20 in juvenile plumage)

1 *Baghdad*, 2 *Felujah*, 1 *Samara*, *Mesopotamia* ; 1 *Fao*, *Persian Gulf* ; 1 Shahdzai Kalat, 1 Rekin 26°24′N.; 65°12′E., Baluchistan ; 1 Wana, NWFP ; 1 Wazirabad, 1 Campbellpur ; 2 Kutch ; 1 Dabka, Baroda ; 1 Dodi, Malwa Plateau, Bhopal ; 1 Rajora, C.P. ; 6 Bombay, 1 Kalyan, Thana, 1 Kolaba ; 1 Betkeri, N. Kanara, 1 Sagar, Mysore ; 1 Trivandrum ; 3 Barkul, 1 Khandpara, Orissa ; 1 Kanpur, 2 Bulandshar, U.P. ; 1 Rajputti, Chupra, 5 Calcutta Market ; 1 Port Blair, Andamans ; 1 *Prome Dist.*, 1 *Sandoway*, *Burma*, 1 *Kashgar*, *Chinese Turkestan.*

Sixteen of the twenty in immature plumage are females. There is some variation in the size of the wing and bill but none of the differences can be geographically isolated. All of them were obtained between 4 September (Kutch) and 5 March (Prome). The differences in the size of the bill as measured and recorded are deceptive and not as distinctive as when seen, for the breadth and thickness are not measured. While the overlap in the size of the wing between the two races is generally accepted, those listed below as *jerdoni* have distinctly smaller bills, having regard to breadth and thickness as well as to length.

If the birds in immature plumage are divided into two groups with larger and smaller bills, their wings do not show much difference in size. The measurements of adults of both races are included :

	Wing	Bill	Tail
Juveniles with small bills (10)	110-117 av. 114·8	13-15 av. 13·57	50-61 av. 54·8
Juveniles with large bills (10)	111-124 av. 114·9	12-15 av. 14	50-60 av. 56·9
Adults ♂♂ (10)	111-123 av. 114·7	12-15 av. 13·5	52-60 av. 55·9
Adults ♀♀ (8)	114-119 av. 116	13-14 av. 13·25	52-61 av. 56·6
jerdoni ♂♂ (13)	103-115 av. 110	11-14 av. 12·5	50-58 av. 54
jerdoni ♀♀ (3)	104, 105, 105	12, 12, 13	52, 56, 56

380 **Charadrius dubius jerdoni** (Legge) (Central India and Ceylon)
Indian Little Ringed Plover **6** : 171

16 : 13 ♂♂ 3 ♀♀

*1 Sind Valley, Kashmir ; 2 Ambala Dist., 1 Bahawalpur, Punjab ; 1 Dadu, Larkana, Sind ; 2 Gwalior ; 1 Ghoti, Nasik ; 1 Khandala ; 1 Godavari Delta ; 2 Bamra, Orissa ; *1 Monghyr, Bihar; 2 *Thayetmyo*, 1 *Tarokmaw, Prome, Burma.*

The birds marked with an asterisk have their bills slightly heavier than in the others, but not as long as in *curonicus*.

This race is said to be smaller than *curonicus* but there is an overlap in wing measurements—the key in IND. HANDBOOK (**2** : 231) separates them from *curonicus* as having the wings 102-114 mm. against 115-121, but the same work goes on to indicate the measurements of 111-120 (♂ and ♀) in *curonicus* and 105-117 in *jerdoni*. The measurement of the bill being indicated 'from feathers' in one and 'from skull' in the other cannot be compared.

In spite of the overlap in the size of the wings the bill, as explained above, is much smaller than indicated by my measurements and seems to be a more reliable index.

In the material available, a difference in wing size between the sexes is visible. Two collected at Bamra, Orissa, on 11 December and 14 March are both marked as breeding. The male has a 115 mm. wing and the female only 105. There is no evidence that this race has a juvenile plumage as in *curonicus*, and the 20 specimens of the species available in this plumage all differ from the adults of this race in their heavier bills and are now placed under *curonicus*. Smythies (1960, BIRDS OF BURMA, p. 189) draws attention to the nominate race and *jerdoni* differing from *curonicus* in this respect ; Henry's (1955, BIRDS OF CEYLON, p. 287) reference to a change in plumage and also to half or less of the lower mandible being yellow-ochre in both races, is probably in error. We have no material from Ceylon and it is quite possible that more than one resident form exists in India, and which may account for the general uncertainty of this note.

A patch of orange at the base of the bill is visible in most of the specimens but it is not possible to ascertain how far it extended in life. Similar remarks apply to the shape and size of the eye-wattle.

The preponderance of females under *curonicus* and the shortage under this form, immediately suggest some error in the identity of those in juvenile plumage under the former. Unless, however, it is established or accepted that female *jerdoni* have larger bills and wings than the males, this apparent anomaly will need some other explanation.

When describing the race *jerdoni* (*P.Z.S.* 1880 p. 38) it was stated that ' the note of the species as observed in its breeding haunts in Ceylon was also different from that of the larger form '.

381 **Charadrius alexandrinus alexandrinus** Linnaeus (Egypt) Kentish Plover **6** : 161

(a) 9 : 5 ♂♂ 2 ♀♀ 2 o ?

1 *Bunder-e-Gaz, W. Astrabad, Caspian Prov.*; 1* *Basra*, 1 *Baghdad*, 1 *Felujah*, 1* *Iskandaryah*, 1 *Sheik Saad*, 2* *Tanb Island, Mesopotamia*; 1 Karachi, Sind.

	Wing	Tail	Bill
♂♂	109-117 av. 111·8	47-50 av. 48·6	15-17 av. 16
♀♀	109, 113	43, 46	15, 16

Five of these (2 March, 1 May, 2 June), including two males described as ' Shot off nest (Karachi) ' and ' Parent of 2 eggs ' respectively, and a third unsexed bird marked ' Nesting ', are pale earthy brown above separating them from all the others of this species. There is a small irregular patch of black on the forehead and the pale head is washed with a yellow rather than chestnut or brown, which may well be mere staining. These birds are marked with an asterisk above. Three others from the same area (October, December, and January) are very slightly paler than others from India, and could really be included with them, as also the one from the Caspian Province (o ?, 11 July, wing 107).

(b) 15 : 6 ♂♂ 8 ♀♀ 1 o ?

1 Bhavnagar, 2 Bodeli, Gujerat; 2 Manori, Salsette, 2 Kolaba; 3 Karwar; 1 Karupadanna, Cochin, 1 Godavari Delta; 1 Puri; 1 Chilka; 1 Rajputti, Chupra.

	Wing	Tail	Bill
♂♂	105-114 av. 108·6 (BR. HANDBOOK 109-118)	41-49 av. 46 (BR. HANDBOOK 43-46)	15-16 av. 15·8 (BR. HANDBOOK 14-15)
♀♀	105-114 av. 109 (BR. HANDBOOK 106-117)	44-49 av. 45·6 —	15-17 av. 15·8 (BR. HANDBOOK 14-15, one 16)

Only two (both males) of the fifteen have black on the forehead. One of them, from Kolaba District, near Bombay (28 January, wing 114), has a slight wash of rufous on the head and nape, while the other

(Bhavnagar, 29 April, wing 106) has none and shows a much more slender bill.

This group no doubt includes a resident and a migrant race, but the absence of a breeding plumage, particularly 'the bright rufous cap' which is said to separate the nominate race from *seebohmi* (IH **2** : 237) appears to extend as far west as Iraq.

Specimen Nos. 14360 and 14361 (♀ Puri, 24 March, and ♂ Chilka Lake 10 January) have their upper parts slightly washed with rufous, approaching a female from Tientsin, China (29 July), which is presumably *dealbatus*.

382 **Charadrius alexandrinus seebohmi** Hartert & Jackson (Aripo, N. Ceylon) **6** : 162

nil.

As indicated under 381 the position is confused, and ringing records and more material are necessary to clarify the arrangement of races in India and the neighbouring countries.

* EL **Charadrius alexandrinus dealbatus** (Swinhoe) (South coast of China, Formosa, Hainan) **6** : 163

6 : 1 ♂ 4 ♀♀ 1 o ?

2 *Thaledan*, 2 *Tarokmaw, Prome* ; 1 *Letpanhla, Henzada, Burma* ; 1 *Tientsin, China.*

Specimen No. 14366 (♂ Thaledan, Prome, 24 March, wing 112) has most of the head and nape rufous, which together with a slight wash of the same colour on the upper parts completely separates it from all the others. A female obtained on the same day is probably of the same race, but neither this nor any of the others (both ♂ and ♀) except for the ♀ from China can be distinguished from those listed under (b) in 381.

383 **Charadrius placidus** J. E. & G. R. Gray (Nepal) Longbilled Ringed Plover **6** : 172

1 o ? Buxa Duars

Wing 144 (139-152) ; tail 74 (76-78) ; tarsus 33 (31-34).

384 **Charadrius mongolus atrifrons** Wagler (Bengal) Pamirs Lesser Sand Plover **6** : 174

42 : 11 ♂♂ 23 ♀♀ 8 o ?

1 Baltistan, 1 Ladakh, Kashmir ; 12 Salsette and Thana, 11 Rewas, Kolaba ; 1 Somwarpet, Coorg ; 1 Parasala, 1 Cape Comorin, Tamil Nadu ; 2 Puri, 1 Chilka Lake, Orissa ; 3 Calcutta Market ; 3 South Andaman ; 3 Car Nicobar ; 2 Katchal, Nicobar.

It has been customary to accept only one race of this species from Indian limits, but considerable differences in the size of the bills of birds from different areas, particularly the Andaman and Nicobar Islands,

* Stuart Baker (**6** : 163) refers to one obtained as far west as Calcutta.

make one wonder if any of the several other races, typical *mongolus*, *pamirensis*, and *stegmanni*, mentioned in BIRDS OF THE SOVIET UNION is really not found within our limits. For the moment, the birds with larger wings and bills have all been included under *leschenaultii* (No. 374), for I can find no other character by which the two species can be separated.

	♂♂	♀♀
Wing	120-128 av. 124·2 (IH ♂♀ 122-132, one 118)	121-131 av. 124·5
Bill	17-19 av. 17·8 (IH 16-19)	17-19 av. 18·7
Tail	44-48, one 53 av. 47 (IH 44-49)	42-53 av. 45·8

While this bird is not accepted as nesting within our limits, it may be worthwhile keeping in mind the fact that a clutch of C/2 believed to be of this species was photographed at Wilpattu, Ceylon, by R. McL. Cameron (*Ceylon Bird Club Notes*, May 1963, p. 19)

384a **Elseyornis melanops**

nil.

This species is not included in SYNOPSIS and INDIAN HANDBOOK but Whistler (*JBNHS* **39**: 251) expressed the opinion that this species was entitled to a place in the Indian avifauna for Jerdon had obtained a specimen at Pulicat Lake, near Madras, and named it *Charadrius russatus* (1840, *Madras Journ. Lit. Sci.* XXIX p. 213).

EL **Eudromias morinellus** (Linnaeus) (Sweden) Dotterel

7 : 3 ♂♂ 4 o ?

2 *Felujah*, 1 *Khamisiyan*, 1 *Baghdad*, 1 *few miles east of Samara*, 1 *Habanmiya Lake*, 1 *Grab Village, Mesopotamia.*

	3 ♂♂	4 o ?
Wing	147, 151, 154	151, 153, 158, 159 (BR. HANDBOOK ♂ 143-152),
Tail	67, 70, 72	67, 68, 69, 70 (BR. HANDBOOK ♀ 61·5-67·5)
Bill from feathers	17, 17, 18 (BR. HANDBOOK 14-16·5)	17, 18, —, — (BR. HANDBOOK 15·5-18)

The bills appear to be a little longer than indicated in BRITISH HANDBOOK.

(*to be continued*)

Amphipoda from the East Coast of India—2

Gammaridea and Caprellidea

BY

T. E. Sivaprakasam

Zoological Survey of India, Southern Regional Station, Madras

(*With eight text-figures*)

[*Continued from Vol.* **66**(2) : 309]

Genus *Parhyale* Stebbing

Parhyale hawaiensis (Dana)

(Fig. 5)

Allorchestes hawaiensis Dana, 1853-55, p. 900, pl. 61, fig. 5 ; Bate, 1862, p. 47, pl. 8, fig. 1.
Hyale hawaiensis Stebbing, 1906, p. 573 ; Schellenberg, 1938 (a), p. 66, fig. 34 ; Ruffo, 1950, p. 57.
Parhyale hawaiensis Shoemaker, 1956, p. 349, figs. 3-4; Ruffo, 1959, p. 17.
Hyale nilssoni Walker, 1904, p. 238 ; 1905, p. 925, fig. 140 (1).
Hyale brevipes Chevreux, 1901, p. 400, figs. 15-18 ; Walker, 1909, p. 337 ; Chilton, 1921, p. 545, fig. 9 ; 1925, p. 536 ; Schellenberg, 1928, p. 658 ; Barnard KH, 1935, p. 292.

Material : Tuticorin : 3 males and 4 females from under seaweeds washed ashore. Ennore estuary : 3 males and 2 females from Enteromorpha weeds. Irakam Island, Pulicat Lake : 3 males from mud pools.

Length : 7 mm.

Remarks : The present specimens are the same as those recorded as *H. brevipes* by Walker (1904, 1905, 1909), Chilton (1921, 1925) and Barnard (1935). Following Schellenberg (1938) and Shoemaker (1956), these specimens are referred to this species though they do not fully agree with its description.

The specimens are characterised by the short and plumpy antennae, gnathopods and peraeopods. Eyes are dark, rounded or reniform. Antenna 1, $\frac{3}{4}$ as long as antenna 2, flagellum with 8-9 joints. Antenna 2, $\frac{1}{5}$ as long as body, flagellum with 8-12 joints. Mouth parts

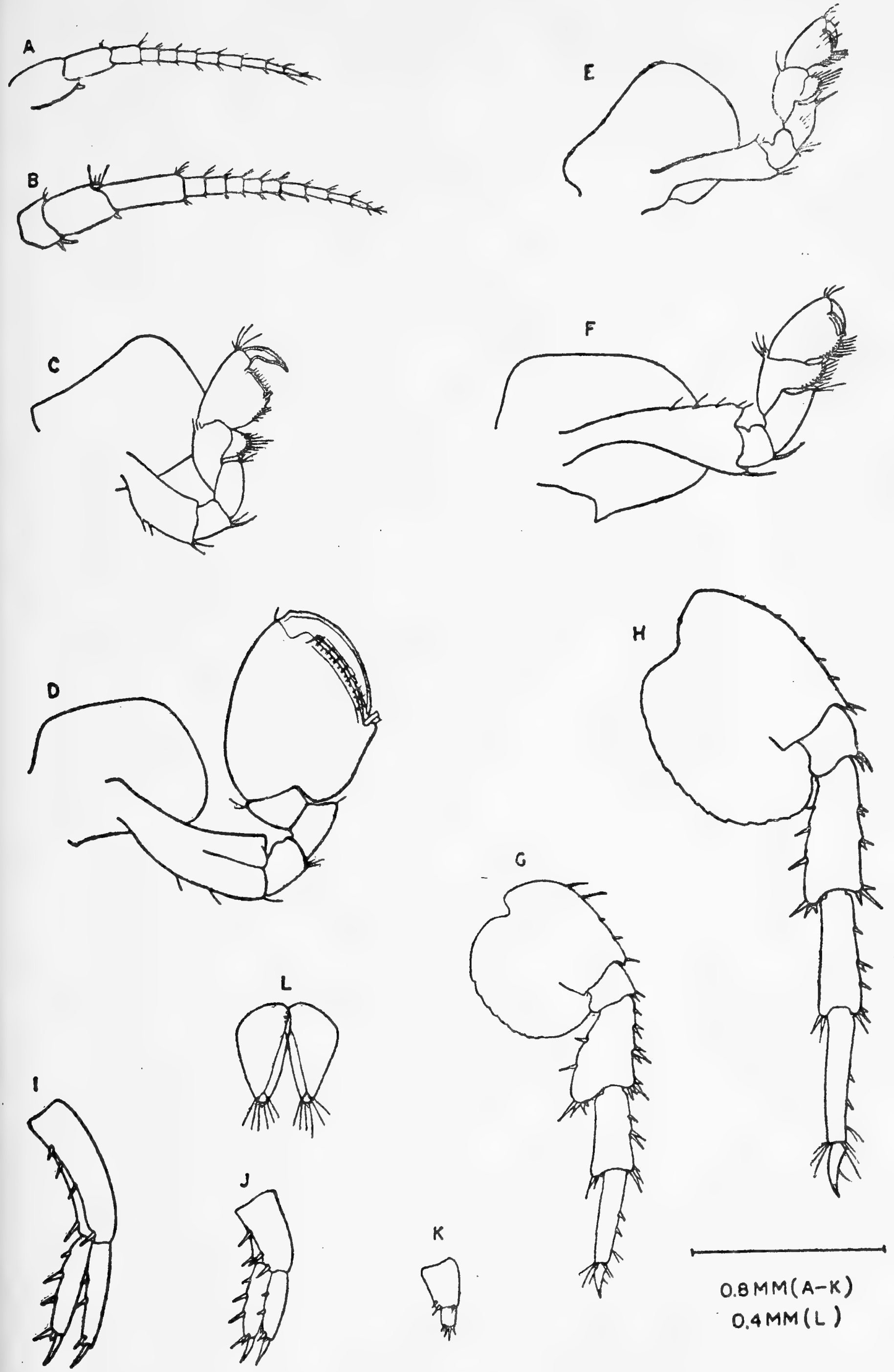


FIG. 5. *Parhyale hawaiensis* (Dana). *Male:* A, antenna 1; B, antenna 2; C, gnathopod 1; D, gnathopod 2; G, peraeopod 3; H, peraeopod 5; I, uropod 1; J, uropod 2; K, uropod 3; L, telson. *Female:* E, gnathopod 1; F, gnathopod 2.

typical of the genus. Gnathopod 1 of male : Side plate quadrate, other joints short and plumpy. Palm straight, at right angle with the hind margin. Dactylus aquiline. Gnathopod 2 of male : 6th joint broadly oval, palm oblique, evenly convex. Gnathopod 1 of female : 5th joint convex in front, hind lobe distinct. 6th joint rectangular, setose hind margin cut off from the palm. Gnathopod 2 of female : 6th joint widening distally, setose hind margin continuous with the palm. Dactyli of peraeopods short, with a stout seta on inner margin. Peraeopod 4 with 2 sets of setae on hind margin of 6th joint. Peraeopod 5 : Hind margin of 2nd joint distinctly serrate and that of 6th joint with 3 sets of setae including the terminal one. Uropod 1 : Peduncle much longer than rami, without a stout distal spine. Uropod 3 : Peduncle more than twice as long as outer ramus, with a minute inner ramus (not noticed previously in Indian specimens). Telson somewhat long, lobes triangular.

Distribution : Nearly cosmopolitan.

Parhyale inyacka (Barnard)

(Fig. 6)

Hyale inyacka Barnard KH, 1916, p. 233, pl. 28, fig. 4 ; Chevreux, 1925, p. 370, fig. 17 ; Stephensen, 1928, p. 590 ; 1933 (b), p. 441, figs. 3-4.
Parhyale inyacka Barnard KH, 1940, p. 472 ; Stephensen, 1948, p. 6 ; Barnard JL, 1955, p. 23, fig. 12.
Hyale hawaiensis Nayar, 1959, p. 30, pl. 10, figs. 10-24.

Material : Hare Island : Several specimens from seaweeds. Tuticorin : Several specimens from under stones and rotting weeds on the shore. Kilakkarai : Several specimens from under stones on the shore along with *Orchestia anomala.* Rameswaram : Several specimens from algae.

Length : 14 mm.

Remarks : These specimens are provisionally referred to this species as there is considerable confusion between this species and *P. hawaiensis.* Shoemaker (1956), in his review of the genus, united *P. inyacka* with *P. hawaiensis* but it was not accepted by Bulycheva (1957) who kept them separate. These specimens, however, closely agree with the description and figures of *P. inyacka* given by Barnard KH (1916, 1940), Stephensen (1933), and Barnard JL (1955).

These specimens are characterised by the following features : Eyes dark, elongate oblong (in terrestrial specimens) or reniform (in aquatic specimens). Antenna 1, ¼ as long as body, flagellum with 12-15 joints. Antenna 2 half as long as body, flagellum with 24-30 joints,

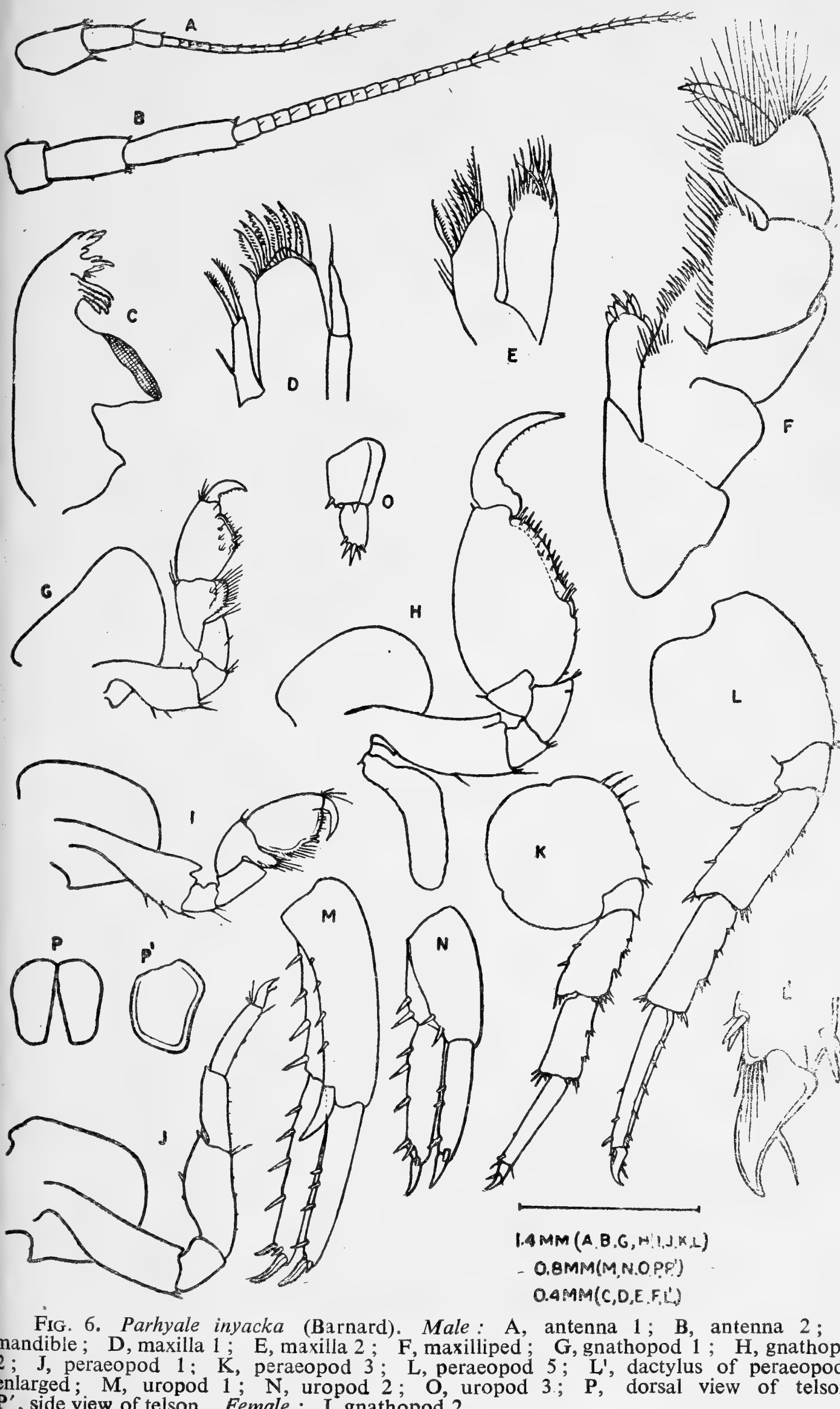


FIG. 6. *Parhyale inyacka* (Barnard). *Male :* A, antenna 1 ; B, antenna 2 ; C, mandible ; D, maxilla 1 ; E, maxilla 2 ; F, maxilliped ; G, gnathopod 1 ; H, gnathopod 2 ; J, peraeopod 1 ; K, peraeopod 3 ; L, peraeopod 5 ; L', dactylus of peraeopod 5 enlarged ; M, uropod 1 ; N, uropod 2 ; O, uropod 3 ; P, dorsal view of telson ; P', side view of telson. *Female :* I, gnathopod 2.

Gnathopod 1 of male : Side plate rounded below, other joints long and not plumpy. Palm slightly oblique. Dactylus aquiline. Gnathopod 2 of male : 6th joint elongate oval in form, palm very oblique, slightly convex. Gnathopod 2 of female similar to the previous but larger. 6th joint elongate, proximal $\frac{2}{3}$ of hind margin produced, with strong setae. Palm slightly oblique, defined by 2 spines. Dactyli of peraeopods short, with a strong seta on inner margin. Peraeopod 3 : Hind margin of 2nd joint finely serrate, with a marked indent in the middle. Peraeopod 4 : with 3 sets of spines and setae on hind margin of 6th joint. Peraeopod 5 : Hind margin of 2nd joint faintly serrate. 4 sets of spines and setae on hind margin of 6th joint. Uropod 1 : Peduncle slightly longer than the rami, with a stout distal spine. Uropod 3 : Peduncle slightly longer than outer ramus. Inner ramus small, distinct. Telson lobes elongate, rounded behind.

Distribution : St. Thomas, Bonaire, Canary Islands, Senegal, Cameroons, South Africa, Hawaii Islands. This is the first record of this species from India.

Family PHOTIDAE

Genus *Audulla* Chevreux

Audulla chelifera Chevreux

(Fig. 7)

Audulla chelifera Chevreux, 1901, p. 432, figs. 56-65 ; Walker & Scott, 1903, p. 225, pl. 14B, fig. 2 ; Stebbing, 1906, p. 737.

Material : Cape Comorin : 1 young male from algae. Pamban : 3 males and 3 females from seaweeds growing on rocks below the railway bridge.

Length : 4·5 mm.

Description : Male : Body slender, 1st segment is the shortest, 3rd pleosome the longest. Urosome depressed. Head as long as first two segments. Eyes medium-sized, dark, oval, ocular lobe conically produced between 1st and 2nd antennae. Side plates small, rounded.

Antennae subequal, half as long as body, fringed with long setae. Antenna 1 : 1st joint of peduncle as long as 3rd but stouter. 2nd joint $1\frac{1}{2}$ times as long as 1st. Flagellum twice as long as 3rd joint of peduncle, with 9-11 joints. Accessory flagellum 4-5 jointed. Antenna 2: 5th joint of peduncle as long as 4th. Flagellum longer than last joint of peduncle, with 9 joints. Mouth parts normal.

Gnathopod 1 : Side plate small, rhomboidal. 2nd joint stout, widening distally. 4th joint twice as long as 3rd. 5th and 6th joints subequal in length, their hind margin with long setae. Palm oblique, straight, undefined. Dactylus as long as palm, swollen at the middle and serrate on inner margin. Gnathopod 2 : Side plate rounded. 2nd joint stout and longer than next three combined. 5th joint triangular, hind lobe with long setae. 6th joint large, oblong ; front and hind margins paral-

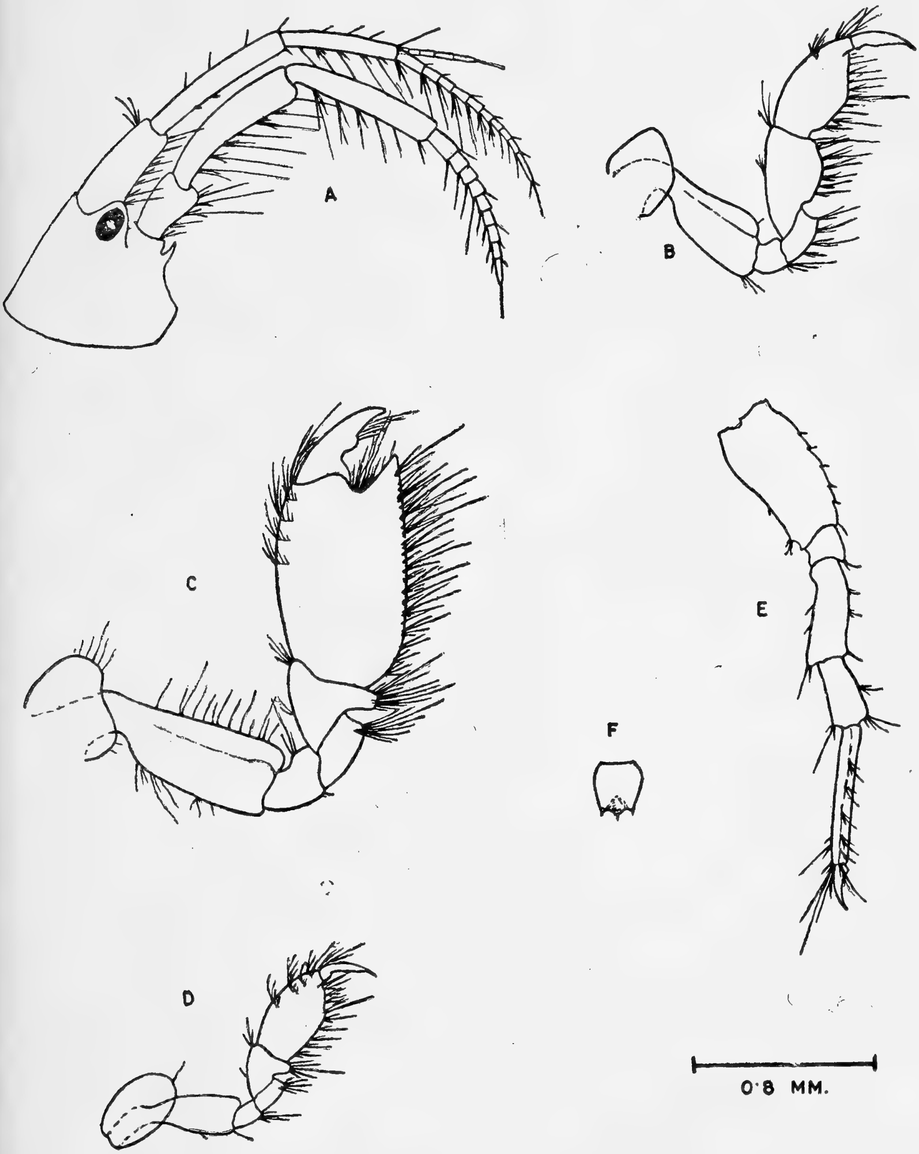


FIG. 7. *Audulla chelifera* Chevreux. *Male :* A, head ; B, gnathopod 1 ; C, gnathopod 2 ; E, peraeopod 5 ; F, telson. *Female :* D, gnathopod 2.

lel ; hind margin fringed with long setae, distally produced into a pointed tooth to meet the tip of dactylus so that the gnathopod is truely chelate. Dactylus short and stout, swollen at the base, followed by a depression and a rounded tooth on lower margin ; it has the form of a parrot's upper beak.

Peraeopods 1 and 2 identical. Peraeopods 3-5 similar, increasing in length. Peraeopod 5 : 2nd joint narrow, rectangular, front margin with 6 spinules. Dactylus thick. Uropods 1 and 2 : Peduncle subequal to inner ramus which is longer than outer. Uropod 3 : Peduncle as long as rami. Telson : Semitubular with a depression dorsally ; distally forming 3 lobes each with a spine.

Female : Gnathopod 1 as in male but smaller. Gnathopod 2 : Smaller than in male. Side plate oval. 2nd joint stout, as long as next three combined. 6th joint oblong, twice as long as 5th ; palm half as long as hind margin, oblique, slightly convex ; long setae on hind margin of joints 4-6. Dactylus long and slender, inner margin serrate.

Remarks : This species, originally described under the family Ischyroceridae, was transferred to Photidae by Walker & Scott (1903). The present material closely agrees their description but the 6th joint of gnathopod 2 of female is not so broad as in their figure.

Distribution : Seychelles Islands, Abd-el-Kuri Island. This species is recorded for the first time in India.

Genus *Photis* Kroyer

Photis digitata Barnard

Photis longicaudata Chilton, 1921, p. 554, fig. 12 (*not* Bate & Westwood).
Photis digitata Barnard KH, 1935, p. 302 ; Nayar, 1959, p. 35, pl. 12, figs. 18-24.

Material : Porto Novo : 2 females from a gastropod shell. Kovelong : 1 female from rock oyster. Madras, Adyar : 4 females from filamentous algae in the estuary. Ennore estuary : Several specimens from oyster rafts. Visakhapatnam harbour : 1 female from wooden rafts.

Length : 4 mm.

Distribution : India.

Photis longicaudata (Bate & Westwood)

Eiscladus longicaudata Bate & Westwood, 1863, p. 412.
Photis longicaudata Sars, 1895, p. 571, pl. 203, fig. 1 ; Walker, 1901, p. 306; 1904, p. 286, pl. 6, fig. 43 ; 1909, p. 339 ; Stebbing, 1906, p. 608 ; Chevreux, 1911, p. 249 ; Barnard KH, 1916, p. 243 ; 1937, p. 164 ; Schellenberg, 1926 (a), p. 231 ; 1928, p. 662 ; Shoemaker, 1945, p. 11, fig. 5 ; Nayar, 1959, p. 34, pl. 12, figs. 1-7.

Material : Devipattinam : 2 males from a Murex shell.

Length : 4 mm.

Distribution : Cosmopolitan.

Photis longimanus Walker

(Fig 8)

Photis longimanus Walker, 1904, p. 286, pl. 7, fig. 44 ; Schellenberg, 1925, p. 175 ; Barnard KH, 1916, p. 244, 1940, p. 479.

Material : Pamban : 7 males and 5 females from seaweeds.

Length : 3 mm.

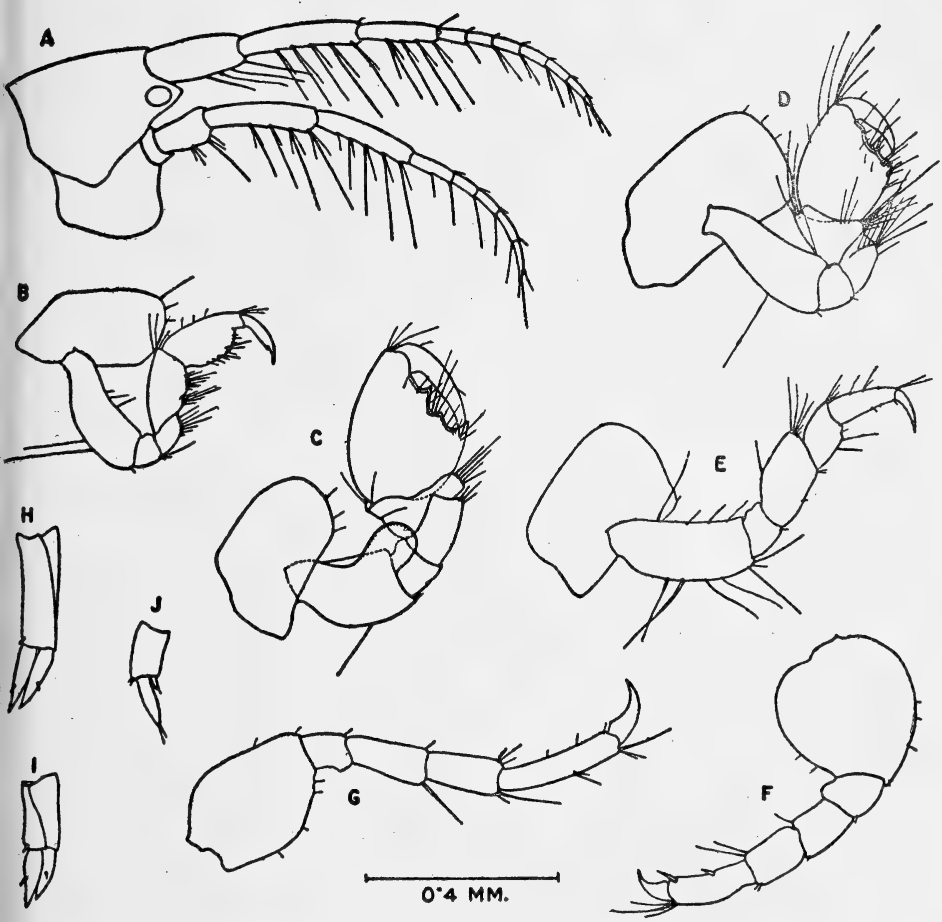


FIG. 8. *Photis longimanus* Walker. *Male :* A, head ; B, gnathopod 1 ; C, gnathopod 2 ; E, peraeopod 1 ; F, peraeopod 3 ; G, peraeopod 5 ; H, uropod 1; I, uropod 2 ; J, uropod 3. *Female :* D, gnathopod 2.

Remarks : These specimens, also collected from the Gulf of Mannar like Walker's (1904) material, closely agree with his description and figures and need no detailed description. The male gnathopods are, however, a little different. Moreover females were not observed by Walker.

Male : Gnathopod 1 : 2nd joint longer than 4th and 5th joints and stouter than 6th. 5th joint as long and wide as 6th, hind margin with two distinct tufts of setae. Palm narrow, undefined. Dactylus with a subterminal tooth on inner margin. Gnathopod 2 : 2nd joint, front margin produced into a large, humplike process. The 3 teeth on palm are more strongly developed. *Female* : Gnathopod 1 as in male. Gnathopod 2 large as in male. 2nd joint without the humplike process, 5th joint not short, triangular, hind lobe not produced. 6th joint as in male, but the palmar teeth and the concave spaces in between are poorly developed.

Distribution : South Africa, Ceylon. This is the first record of this species from India.

Genus *Eurystheus* Bate

Eurystheus afer (Stebbing)

(Fig. 9)

Gammaropsis afra Stebbing, 1888, p. 1097, pl. 113.
Eurystheus afer Stebbing, 1906 ; p. 612, 1908 (a), p. 87 ; 1910, p. 461 ; Schellenberg, 1928, p. 662 ; Barnard KH, 1916, p. 249, pl. 28, fig. 11; 1937, p. 165, fig. 12 ; 1940, p. 479 ; Pillai, 1957, p. 55, fig. 13 (1-4).
Protomedeia ? afra Della Valle, 1893, p. 440.

Material : Rameswaram : 1 male from algae. Pamban : 2 males from seaweeds.

Length : 5 mm.

Remarks : These specimens closely agree with the description and figures of Barnard (1937) and Pillai (1957). This species differs from *E. atlanticus* (Stebbing) in the structure of the ocular lobes and the male gnathopod 2.

Distribution : South Africa, Gulf of Suez and Bagamoyo, Zanzibar and India. This species is recorded for the first time from the east coast of India.

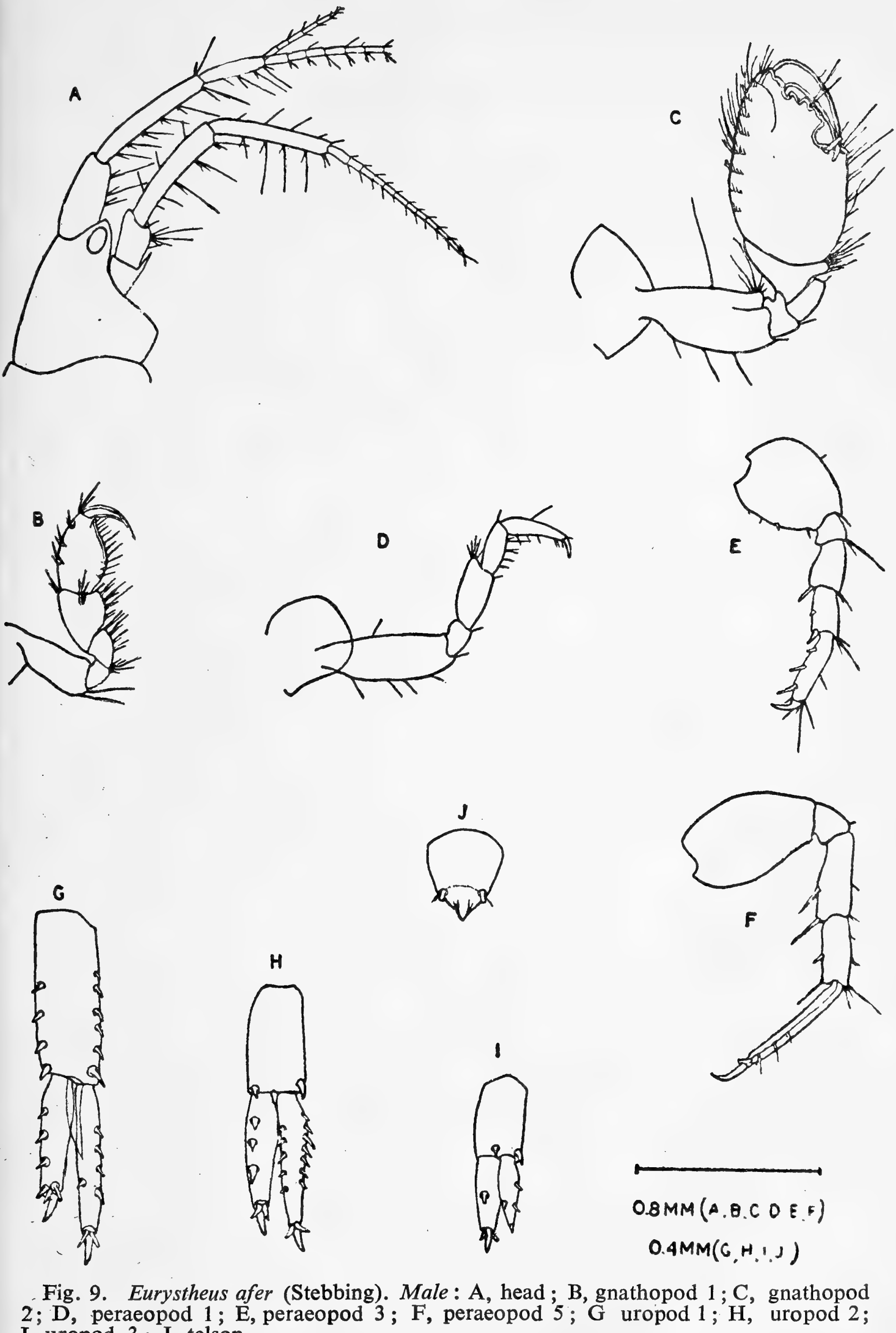


Fig. 9. *Eurystheus afer* (Stebbing). *Male* : A, head ; B, gnathopod 1 ; C, gnathopod 2 ; D, peraeopod 1 ; E, peraeopod 3 ; F, peraeopod 5 ; G uropod 1 ; H, uropod 2 ; I, uropod 3 ; J, telson.

Eurystheus digitatus Schellenberg

(Fig. 10)

Eurystheus digitatus Schellenberg, 1938 (a), p. 84, figs. 44 a-f.

Material : Kilakkarai : 1 female from seaweeds. Pamban : 12 males and 12 females from seaweeds below the railway bridge.

Length : 5 mm.

Remarks : The present material is strikingly similar to the description and figures of Schellenberg (1938). The oblique, stridulating palm of gnathopod 1 and the rectangular 6th joint with a long, spurlike pro-

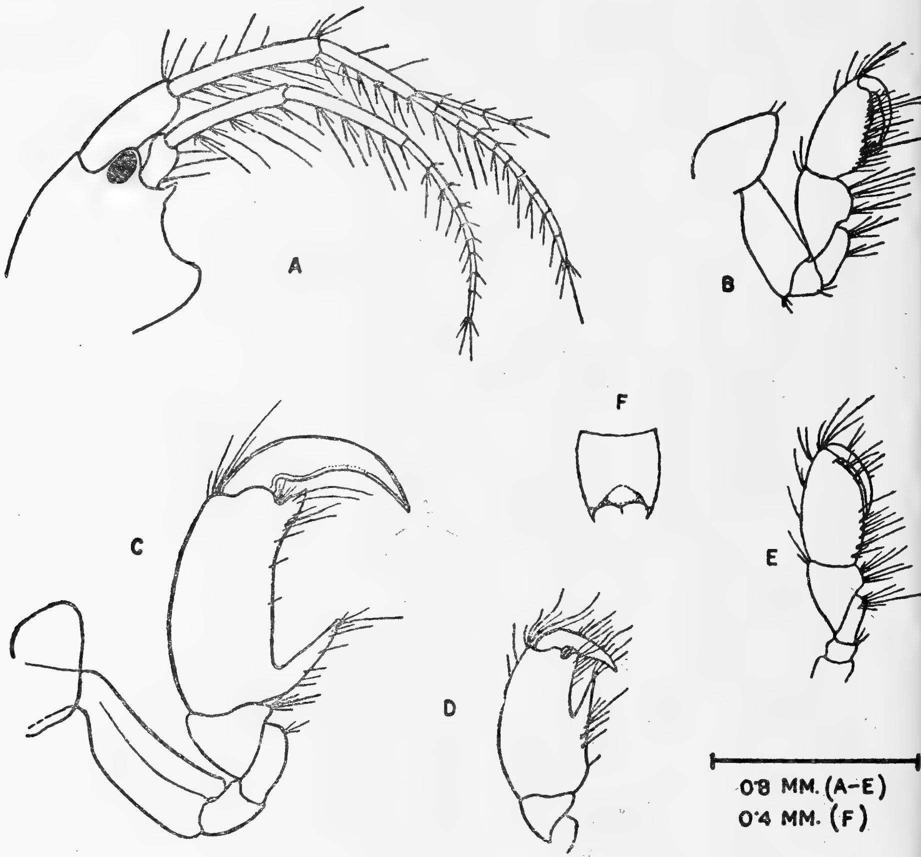


Fig. 10. *Eurystheus digitatus* Schellenberg. *Male* : A, head ; B, gnathopod 1 ; C, gnathopod 2 of adult ; D, gnathopod 2 of young ; F, telson. *Female* : E. gnathopod 2.

cess from the base of hind margin and the falcate dactylus (as in *Jassa falcata*) of gnathopod 2 of male are characteristic of this species.

Distribution : Ellice and Gilbert Islands (South Pacific Ocean). In India this species is recorded for the first time.

Eurystheus sp.

Material : Madras, Royapuram : 30 specimens from the washings of holothurians and stones.

Length : 5·5 mm.

Remarks : The author is unable to identify these specimens for want of sufficient literature. They have the following features : Ocular lobes well-developed, acute in front. Eyes dark, oblong, Antennae fringed with long setae on lower margin. Antenna 1 : Flagellum shorter than peduncle, with 9-10 joints. Accessory flagellum 4-jointed. Antenna 2 : Flagellum with 9-10 joints, shorter than peduncle. Mouth parts typical of the genus. Gnathopod 1 of male : 6th joint oblong, palm about half as long as front margin, slightly oblique and convex. Dactylus slender, serrate on inner margin. Gnathopod 2 of male : Almost naked. 4th joint produced distally and partly encircling base of 6th joint. 5th joint triangular, not produced behind between 4th and 6th joints. 6th joint large, widest at the base, narrowing distally. Palm narrow, with a tubercular prominence near hinge of dactylus followed by a long, very oblique, concave part and defined posteriorly by a small, pointed tooth produced distally from hind margin. Hind margin $\frac{1}{3}$ as long as front, with 2 setiferous notches distally. Dactylus large, falcate, its tip impinging the corner tooth of palm. Gnathopod 1 of female as in male. Gnathopod 2 of female : Hind lobe of 5th joint rounded, setose. 6th joint setose, palm oblique, wavy, with an anterior convex portion and defined by a stout spine. Dactylus serrate on inner margin. Peraeopods and uropods typical of the genus. Telson semicylindrical, hollowed out posteriorly and produced medianly below into an acute lobe. Lateral angles each with a spine and a seta.

Family AMPITHOIDAE

Genus *Ampithoe* Leach

Ampithoe ramondi Audouin

(Fig. 11)

Ampithoe ramondi Audouin, 1826, p. 93, pl. 11, fig. 6 ; Schellenberg, 1936, p. 19, 1938 (a), p. 87 ; Ruffo, 1938 (a), p. 146.

Ampithoe ramondi Bate, 1862, p. 239, pl. 42, fig. 1 ; Schellenberg, 1928, p. 665 ; Barnard KH, 1935, p. 305, 1937, p. 170 ; 1940, p. 480 ; 1955, p. 7 ; Pirlot, 1938, p. 346 ; Shoemaker, 1942, p. 40 ; Barnard JL, 1955, p. 28.

Ampithoe vaillantii Chevreux, 1901, p. 418 ; 1911, p. 26, pl. 20, figs. 1-4 ; Walker, 1904, p. 291 ; Chevreux & Fage, 1925, p. 333, fig. 341-342 ; Crawford, 1936, p. 104 Reid, 1951, p. 264.

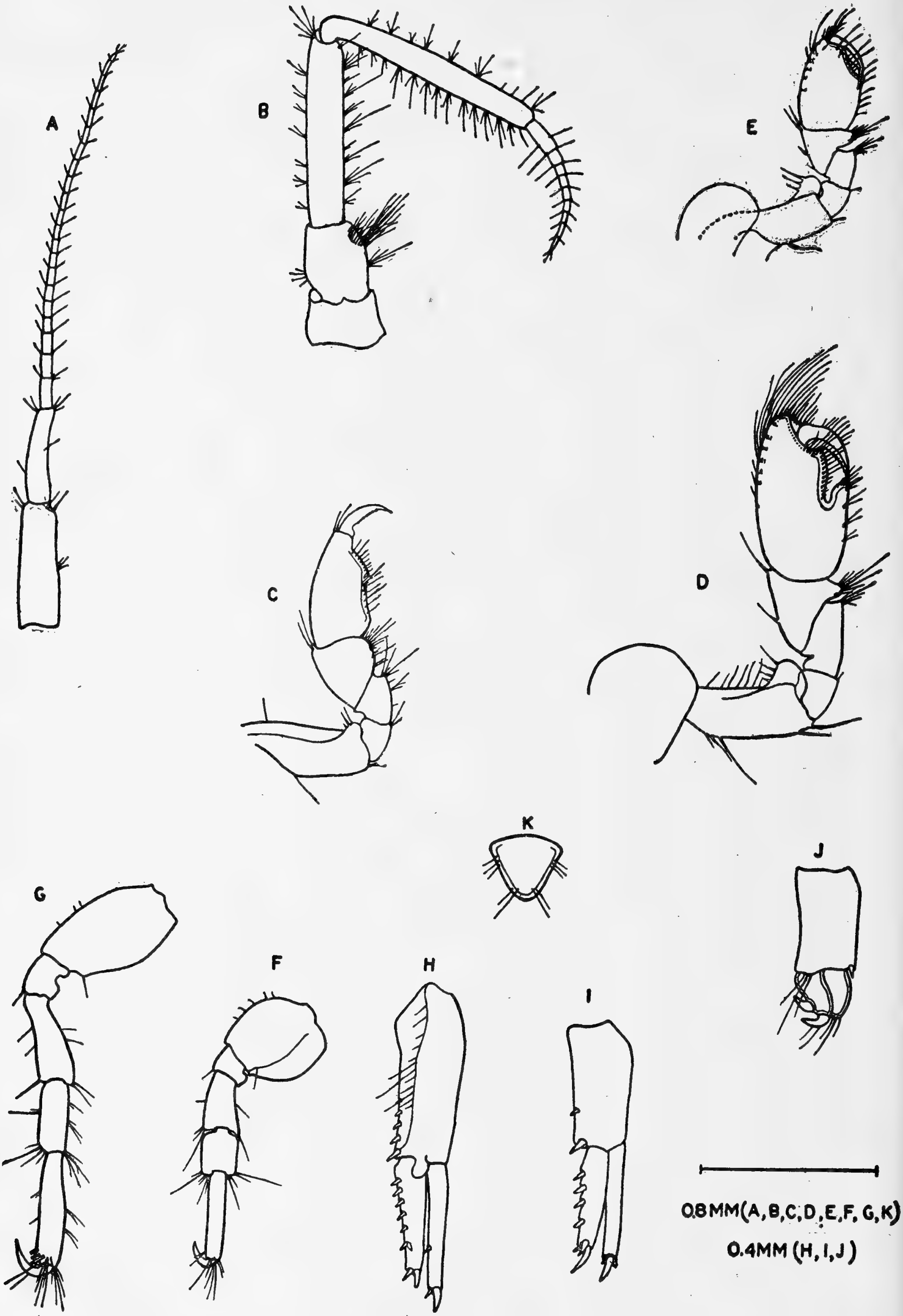


Fig. 11. *Ampithoe ramondi* Audouin. *Male* : A, antenna 1; B, antenna 2; C, gnathopod 1; D, gnathopod 2; F, peraeopod 3; G, peraeopod 5; H, uropod 1; I, uropod 2; J, uropod 3; K, telson. *Female* : E, gnathopod 2.

Ampithoe vaillantii Bate, 1862, p. 245, pl. 42, fig. 6 ; Stephensen, 1915, p. 51 ; Barnard KH, 1916, p. 253.
Ampithoe divisura Shoemaker, 1933, p. 255, fig. 9.
Ampithoe intermedia Walker, 1904, p. 290, pl. 7, fig. 46 ; 1905, p. 931 ; 1909, p. 341 ; 1916, p. 346 ; Chevreux 1908, p. 515, fig. 29 ; Shoemaker, 1921, p. 102.
Ampithoe intermedia Stebbing, 1906, p. 738 ; 1910, p. 462.
Ampithoe lobata Walker, 1909, p. 342, pl. 43, fig. 9.

Material : Pamban : 3 males and 1 male from seaweeds.

Length : 5 mm.

Remarks : The 2nd gnathopod of male in this species is subject to considerable variation in shape and this has led to the rather long list of synonymy.

The present material closely agrees with Walker's (1904) description of *A. intermedia* which has been synonymised with the present species. A large male (5 mm.) was a little different in the structure of antennae and the gnathopods. Body and appendages with small rounded cuticular thickenings. 4th and 5th joints of peduncle of antenna 2 rather elongated ; flagellum shorter, $\frac{2}{3}$ as long as 5th joint. Gnathopod 1 : Front margin of 2nd joint with a small distal lobe ; 6th joint much longer, $1\frac{1}{2}$ times as long as 5th, hind margin slightly concave, continuous with the narrow palm and granular in appearance. Gnathopod 2 : Front margin of joint 2 distally produced into a large humplike process ; 6th joint longer, twice as long as 5th, the palmar cleft U-shaped rather than V-shaped.

Distribution : Cosmopolitan in tropical and subtropical seas.

Genus *Cymadusa* Savigny

Cymadusa microphthalma (Chevreux)

(Fig. 12)

Grubia microphthalma Chevreux, 1901, p. 422, figs. 46-49 ; Walker, 1905, p. 930, fig. 142 & pl. 88, fig. 15 ; Stebbing, 1906, p. 738.

Material : Cape Comorin : 3 females from algae. Kilakkarai : 1 male and 6 females from algae. Devipattinam : 1 female from sponges. Nambuthalai : 1 male from algae.

Length : 10 mm.

Description : *Male :* Head as long as first two segments. Eyes very small, oval, colourless in spirit (was probably red in life). Body smooth, with grey or violet patches and dots all over. 1st segment is the shortest, 3rd pleosome longest. Side plates large, oblong, smoothly rounded.

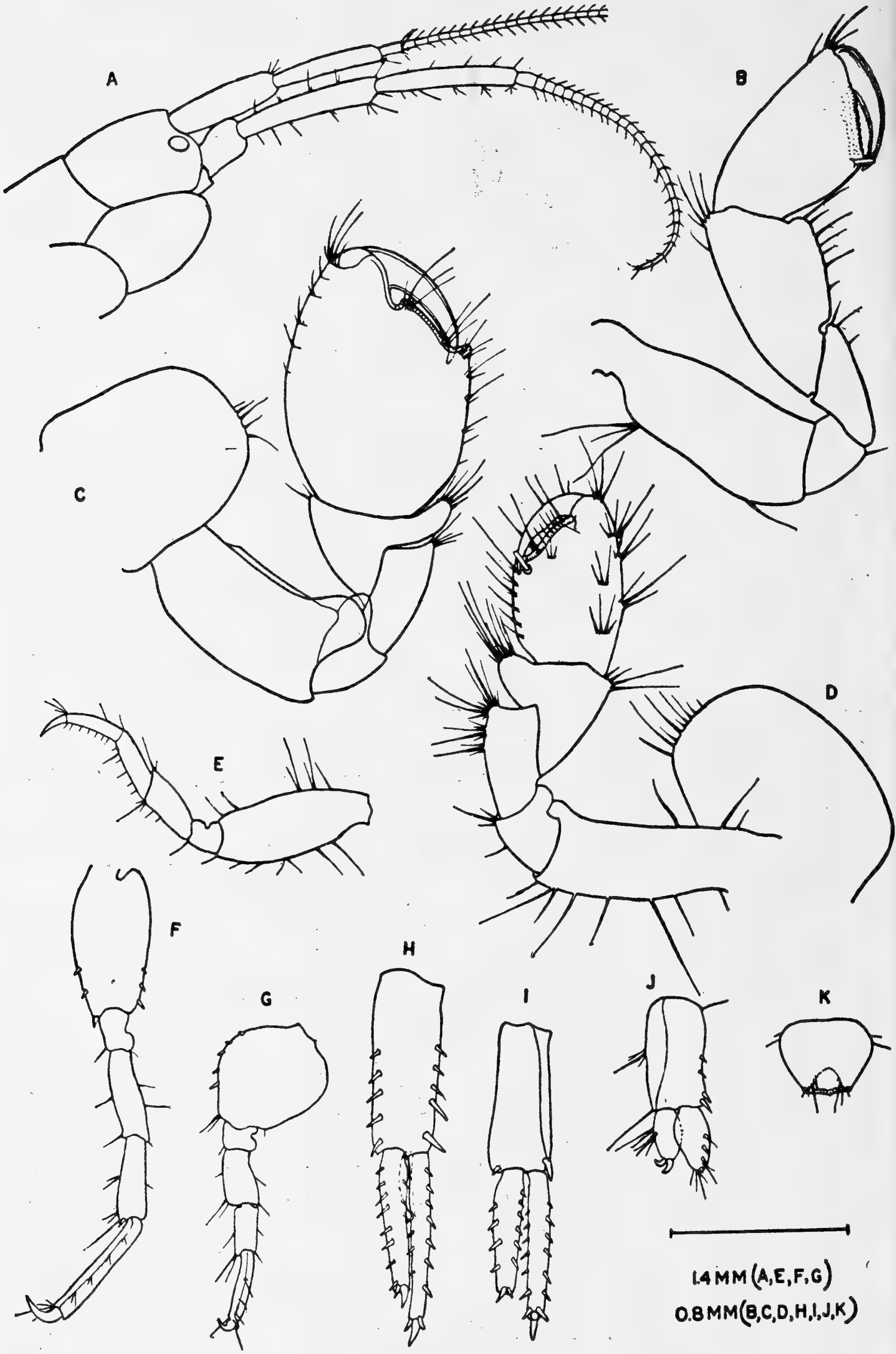


FIG. 12. *Cymadusa microphthalma* (Chevreux). *Male:* A, head; B, gnathopod 1; C, gnathopod 2; E, peraeopod 1; F, peraeopod 5; G, peraeopod 3; H, uropod 1; I, uropod 2; J, uropod 3; K, telson. *Female:* D, gnathopod 2.

Antenna 1, $\frac{3}{4}$ as long as body. 1st joint of peduncle subequal in length to the next and twice as broad. 3rd joint small. Flagellum more than thrice the length of peduncle, 35-jointed. Accessory flagellum 2-jointed, the 2nd minute. Antenna 2, $\frac{2}{3}$ as long as antenna 1. 4th and 5th joints of peduncle subequal in length ; flagellum nearly as long as peduncle, with 24 joints. Mouth parts as figured for *C. sardenta.*

Gnathopod 1 : A little longer than gnathopod 2, finely granulose and with fewer setae. 2nd joint stout, as long as 4th and 5th joints combined widening distally. 5th joint as long as 6th, constricted at the base, hind margin with a few setae and front margin distally with 4-5 stout setae. 6th joint widening distally, with 4-5 stout setae at the distal end of front margin. Palm well-defined by a stout spine, shorter than the hind margin and slightly concave. Dactylus strong, curved. Gnathopod 2 : robust. Side plate nearly rounded. 2nd joint stout, as long as 6th joint ; front margin distally produced into a rounded lobe. 3rd joint also with such a lobe. 4th joint oblong. 5th joint short, subtriangular, hind lobe with long setae. 6th joint large, elliptical, both margins with short setæ. Palm oblique, with a sinus following the hinge of dactylus and a granular setose prominence which smoothly descends to a tooth that defines the palm. Dactylus strong, its tip meeting the palmar tooth.

Peraeopods 1 and 2 identical. 2nd joint remarkably stout and strong. Peraeopod 3 : 2nd joint very much dilated at about the middle, tapering distally, front margin with 5 spines. Peraeopod 5 : Similar to the preceding but longer. 2nd joint sub-oblong, tapering distally, with a notch at the base ; hind and front margins each with 3 spines on distal half ; 6th joint as long as 3rd and 4th combined. Dactylus strong, curved. Uropods 1 and 2 : Outer ramus shorter than the inner which is subequal to peduncle, with spines as shown. Uropod 3 : Peduncle twice as long as outer ramus which is shorter than the inner, and with 2 recurved spines at the tip. Telson broader than long, tapering a little behind ; hind margin nearly straight and a little concave dorsally ; setae as shown in the figure.

Female : Gnathopod 1 as in male but much slender. Gnathopod 2 with stiff setae on all joints. Side plate oblong, rounded below. 2nd joint stout, as long as next three combined, front margin distally produced into a small lobe. 4th joint oblong, 5th triangular. 6th joint as in male but not large. Palm oblique, defined by a tooth and a spine and with a small prominence near the hinge of dactylus.

Remarks : Chevreux (1901) described only the females and the males were described later by Walker (1905). The present material closely agrees with Walker's description and figures. Pirlot (1939) united this species with *C. filosa,* but the present material is very different from *C. filosa* as described by Schellenberg (1928) and Nayar (1959) and hence treated as a distinct species.

Distribution: Seychelles Is., Minicoy Is. and India. This is the first record of this species from the Indian peninsula.

(*to be continued*)

Orchids of Nepal—2

BY

M. L. Banerji[1] and B. B. Thapa[2]

(*With eleven text-figures*)

[*Continued from vol.* **66** (2) : 296]

Three genera are dealt with in this paper, they being *Coelogyne* Lindl., *Pleione* D. Don, and *Panisea* Lindl.

Coelogyne Lindl.

Epiphytic, pseudobulbs with usually two plicate coriaceous or membraneous leaves. Flowers in racemes or on short scapes. Sepals usually very concave, mentum or spur absent. Petals usually much narrower than the sepals. Labellum 3-lobed, lateral lobes broader, erect on both sides of the column, long, winged or hooded round the tip. Anthers pendulous by short filaments, tip resting on large rostellum which is divaricate. Pollinia 4.

Artificial key to the species of *Coelogyne*

A. Flowers from an undeveloped pseudobulb at the base of the old pseudobulb. Sheaths of the scape all basal—

B. Racemes pendulous or decurved, many or few flowered—

C. Flowers *c.* 1·5 cm. in diam., side-lobes of lip large, rounded, disk with 3 yellow ridges.. *flaccida*

CC. Flowers large, side-lobes of lip large, rounded with yellow fimbriate lamellae between them, mid-lobe with 2 broad yellow plates....*cristata*

BB. Racemes erect or inclined, rarely drooping, many or few flowered—

C. Lip white with 4 yellow spots, side-lobes erose, mid-lobe ovate or ovate-lanceolate, disk with 3 ridges............................*corymbosa*

CC. Lip white with confluent orange and yellow areas, side-lobes finely serrulate, mid-lobe ovate, disk with 2 ridges............................*ochracea*

CCC. Lip spotted with brown, side-lobes elongate, mid-lobe clawed, orbicular, disk with 3 brownish ridges...............................*fuscescens*

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[1] University of Kalyani, Kalyani, W. Bengal.
[2] Horticultural Assistant, Indian Co-operation Mission, Kathmandu.

AA. Flowers from the top of the mature pseudobulb—

B. Scape sheathed at the base only—Lip white or yellowish, surface and margin of lobes with long brown hairs..*ovalis*

BB. Scape with distichous imbricating sheaths below the racemes only—

C. Flowers large, 2·5 cm. in diam. or more—

D. Lip white with yellow blotches, side-lobes narrow, mid-lobe rounded-ovate.. .... *elata*

DD. Lip white with 3 big orange coloured spots, side-lobes small and acute, mid-lobes subpanduriform .... *uniflora*

CC. Flowers small, *c.* 1·5 cm. in diam., lip white, side-lobes obtuse, mid-lobe obcordate.. *flavida*

Coelogyne corymbosa Lindl. Fol. Orch. (Coelog.) 7, 1855 ; F.B.I. 5 : 831, 1890 ; King & Pantl. in Ann. Roy. Bot. Gard. Calc. 8 : 134, t. 185, 1898 ; Hara in Fl. Eastern Himal. 428, 1966. (Fig. 1).

Flowers pure white, sweet smelling ; sepals and petals narrow, lanceolate, acute, white ; lip white with 4 yellow spots (eyes), side lobes erose, mid-lobe ovate or ovato-lanceolate, disk with 3 ridges. *Flowering* during March and April ; distributed between 1,800 to 2,700 metres. Collected from Rhingmo to Jubin, Khera, Sheopuri, Borlong, Helembu ; locality unknown (Herklott).

C. cristata Lindl. Collect. Bot. t. 32, 1821 ; F.B.I. 5 : 829, 1890 ; King & Pantl. 132, t. 184, 1898 ; Hara, 429, 1966. (Fig. 2).

Flowers large with a shade of yellow ; sepals and petals subequal, broad, obtuse, white ; lip with large side lobes, rounded, yellow fimbriate lamellae between the side lobes and the mid-lobe, mid-lobe orbicular with 2 broad yellow plates. *Flowering* during March and April widely distributed between 1,500 to 1,800 metres. Collected from Simbhanjang, Mahavir, Godavari, Sheopuri, Chandragiri, Kakni ; locality unknown (Herklott, Parker).

C. elata Lindl. Gen. et Spec. Orch. 40, 1830 ; F.B.I. 5 : 838, 1890 ; King & Pantl. 136, t. 188, 1898 ; Hara, 429, 1966. (Fig. 3).

Flowers large, white ; sepals oblong-lanceolate, petals linear ; lip white with yellow blotches, side lobes narrow, mid-lobe rounded-ovate, acute, tipped with a reddish tint. *Flowering* during March and April ; distributed between 1,200 to 2,000 metres. Collected from Komaltar thumki, Sheopuri, Sundarijal, Shimbhanjang, Godavari ; locality unknown (Herklott).

C. flaccida Lindl. Gen. et Spec. Orch. 39, 1890 ; F.B.I. 5 : 829, 1890 ; King & Pantl. 133, t. 183, 1898. (Fig. 4).

Flowers white, *c.* 1·5 cm. in diam., faint smelling ; sepals linear-

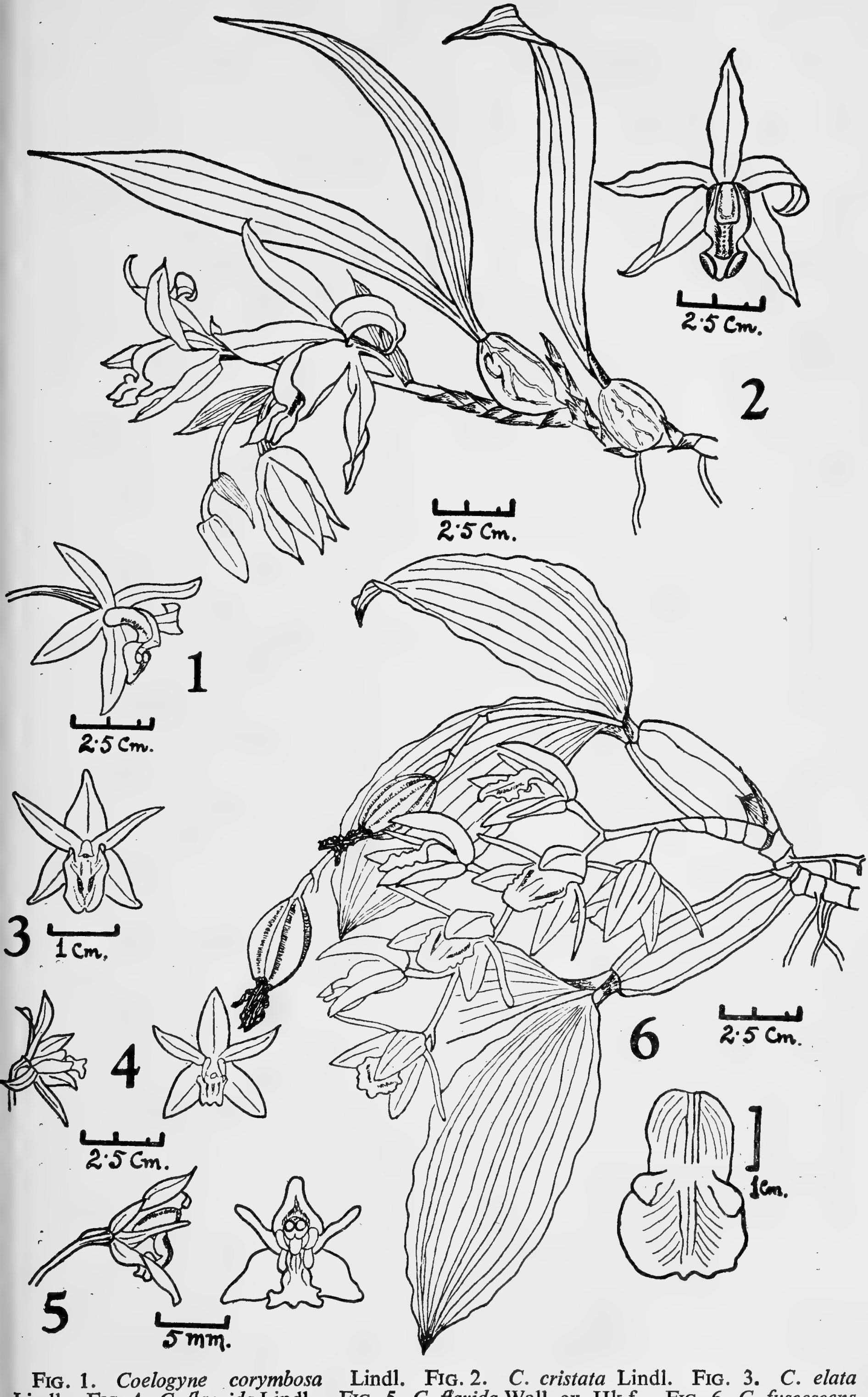


FIG. 1. *Coelogyne corymbosa* Lindl. FIG. 2. *C. cristata* Lindl. FIG. 3. *C. elata* Lindl. FIG. 4. *C. flaccida* Lindl. FIG. 5. *C. flavida* Wall. ex. Hk.f. FIG. 6. *C. fuscescens* Lindl.

oblong, acute, petals narrower, acuminate ; side-lobes of the lip larger, rounded, brownish, mid-lobe small, broad, ovate, disk with 3 yellow ridges. *Flowering* during April and May ; distributed in the subtropical belt. Collected from Sundarijal, Pokhra ; locality unknown (Herklott).

C. flavida Wall. ex Hk. f. in Fl. Brit. Ind. 5 : 839, 1890 ; King & Pantl. 139, t. 191, 1898 ; Hara, 429, 1966. (Fig. 5).

Flowers small, yellow ; sepals oblong, acute, petals filiform ; side lobes of lip small, obtuse, slightly turned on the mid-lobe, mid-lobe obcor date, disk with two ridges. *Flowering* time during May and June ; distributed up to 1,500 metres. Collected from Namsaling to Gorkha, Lamidanda, below Sheopuri ; locality unknown (Herklott).

C. fuscescens Lindl. Gen. et Spec. Orch. 41, 1830 ; F.B.I. 5 : 833, 1890 ; King & Pantl. 132, t. 181, 1898. (Fig. 6).

Flowers very variable in colour, usually greenish-yellow ; sepals oblong, acute, and very narrow, 1-3 nerved, petals greenish-yellow or slightly pinkish ; lip spotted with brown, side lobes elongate, free ends small, obtuse, mid-lobe clawed, orbicular, disk with 3 brownish ridges. *Flowering* during September to November ; distributed between 900 to 1,800 metres. Collected from Markhu, Sankhoo, Sundarijal, and Godavari.

C. ochracea Lindl. Bot. Reg. 1846, t. 69, 1846, et Fol. Orch. 5 : 1854 ; F.B.I. 5 : 831, 1890 ; King & Pantl. 132, t. 182, 1890 ; Hara, 429, 1966. (Fig. 7).

Flowers light yellow ; sepals linear-oblong, acute, petals narrower than the sepals ; lip white with confluent orange and yellow areas, side lobes finely serrulate, mid-lobe broad, ovate, disk with 2 ridges. *Flowering* time April and May ; distributed between 1,500 to 2,500 metres. Collected from Chuwwa to Aisalukharka, Simbhanjang, Chandragiri ; locality unknown (Herklott).

C. ovalis Lindl. Bot. Reg. 1838, Miscl. 91 ; F.B.I. 5 : 836, 1890 ; King & Pantl. 135, t. 187, 1898. (Fig. 8).

Scape 1-3 flowered, flowers white, rarely with a shade of purple ; sepals ovate-lanceolate, faintly yellowish, petals filiform ; lip white or yellowish, sometimes with a shade of purple, surface and margin of lobes with long brown hairs. *Flowering* time during September and October ; distributed between 1,200 to 1,800 metres. Collected from Sundarijal, Markhu, Chandragiri ; locality unknown (Herklott).

C. uniflora Lindl. Gen. et Spec. Orch. 42,1830 ; F.B.I. 5 : 842, 1890 ; King & Pantl. 138, t. 192, 1898.

Flowers creamy-yellow ; sepals lanceolate, petals lanceolate ; lip with acute side lobes, mid-lobe subpanduriform, 3 big orange coloured

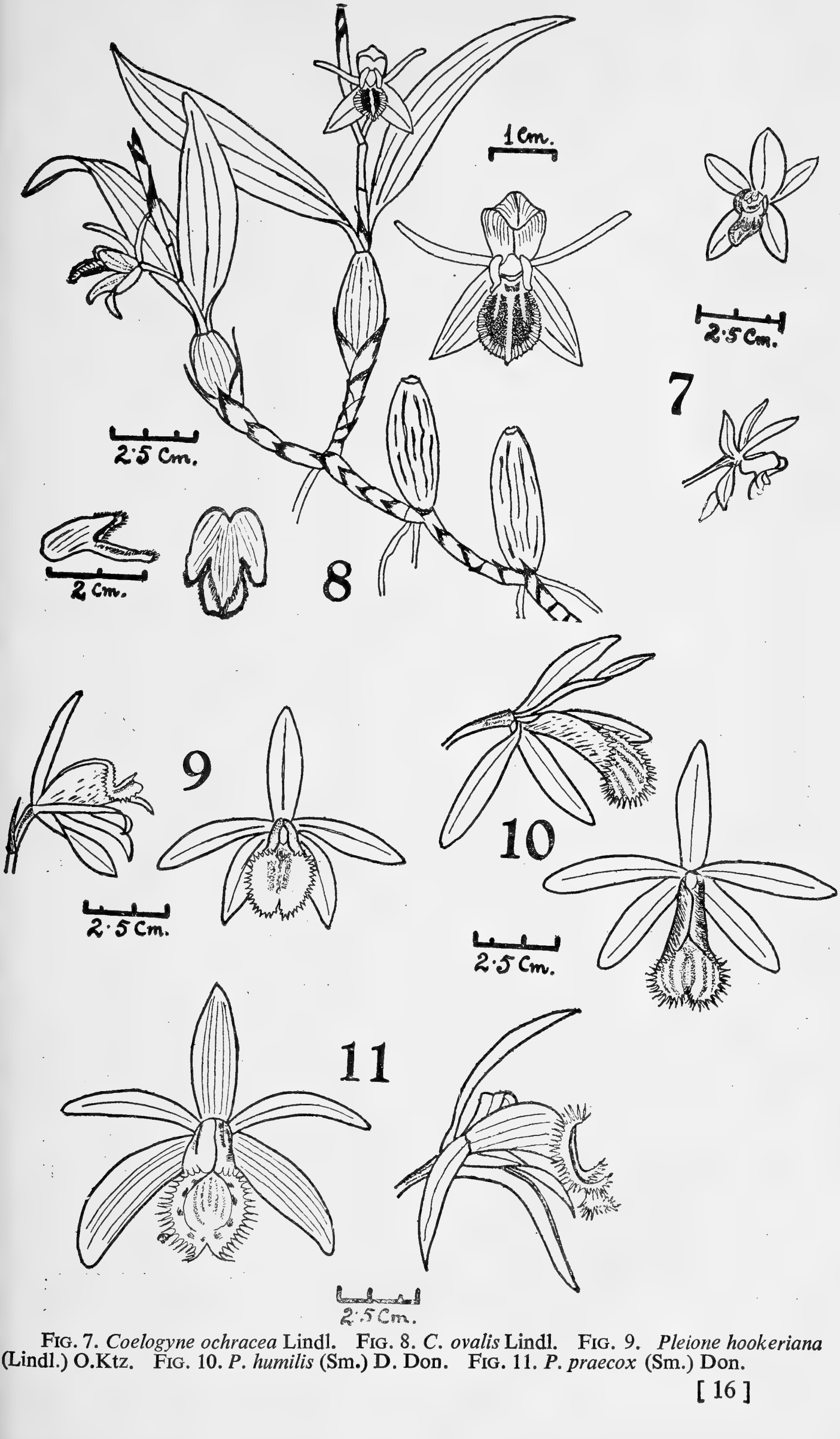


FIG. 7. *Coelogyne ochracea* Lindl. FIG. 8. *C. ovalis* Lindl. FIG. 9. *Pleione hookeriana* (Lindl.) O.Ktz. FIG. 10. *P. humilis* (Sm.) D. Don. FIG. 11. *P. praecox* (Sm.) Don.

[16]

spots. *Flowering* during April and May. Collected only once from Lamidanda *c.* 1,500 metres. F.B.I. gives '3-7 orange spots' on the mid-lobe, but our specimens had only 3 spots.

Pleione D. Don

Mostly terrestrial, pseudobulbs with one or two leaves. Flowers arising from the base of the pseudobulbs. Sepals valvate, free or connate at the base. Labellum with obscure lateral lobes or the lateral lobes are absent, margin serrate or dentate, apically lobed. Foot of column absent. Anther with short filament, pollinia 4.

ARTIFICIAL KEY TO THE SPECIES OF *Pleione*

Flowers appearing before or after the leaves—
  Lip lacinate or deeply fringed, bifid.................................*praecox*
  Lip fimbriate, speckled or striped with deep purple..................... *humilis*
Flowering scape 1-leaved. Lip margin crisp and toothed..............*hookeriana*

Pleione hookeriana (Lindl.) O. Ktz. Rev. Gen. Pl. 2 : 680, 1891 ; Hara 448, 1966. *Coelogyne hookeriana* Lindl. Fol. Orch. 14, 1854 ; F.B.I. 5 : 842, 1890 ; King & Pantl. t. 193, 1898 (Fig. 9).

Flowering scape with one flower, 5 cm. in diam. ; sepals and petals subsimilar, oblong, lanceolate, acute, pale rose-purple ; lip with few blotches, disk with 5 yellow ciliate ridges, margin crisp, and toothed. *Flowering* during May and June ; distributed between 2,100 to 3,000 metres. Collected from Puyian, Reserve forest above Dingla, Topkegola area, Jiri ; locality unknown (Herklott).

P. humilis (Sm.) D. Don, Prodr. Fl. Nep. 37, 1825 ; Hara, 448, 1966 ; *Epidendrum humilis* Smith, Exot. Bot. 2 : 75, t. 98, 1804-1807 ; *Coelogyne humilis* Lindl. Gen. et. Spec. Orch. 53, 1830 ; F.B.I. 5 : 840, 1890 ; King & Pantl. 139, t. 194, 1898 (Fig. 10).

Flowers pale purple. Lip obovate, fimbriate, speckled or striped with deep purple, disk with fringed lamellae, top of column truncate and toothed. *Flowering* during February and March ; distributed between 2,100 to 2,850 metres. Collected from Bagdoar, Ghorepani, west face of Phulchowki ; locality unknown (Herklott).

F.B.I. gives the colour of the flower as also white and the stripes or speckles on the lip as red, purple, orange or brown, but we have in all cases found the flowers of pale purple colour and the stripes or speckles of a deeper colour.

P. praecox (Sm.) D. Don, Prodr. Fl. Nep. 37, 1825 ; Hara, 449, 1966 ; *Epidendrum praecox* Smith, Exot. Bot. 2 : t. 97, 1804-1807 ; *Coelogyne* *praecox* (Sm.) Lindl. Fol. Orch. 16, 1863 ; F.B.I. 5 : 840, 1890 ; King & Pantl. 141, t. 196, 1898. (Fig. 11).

Flowers rose-purple, sweet smelling; sepals narrow, slightly curved, acute, petals broader than the sepals, lower slightly curved ; lip lacinate or deeply fringed in front, bifid, disk with crested lamellae, top of column 4-toothed. *Flowering* during September and October ; distributed between 1,700 to 2,700 metres. Collected from Kharidhunga, Kakni, Sheopuri, Daman ; locality unknown (Herklott).

Panisea Lindl.

This genus is very near to *Coelogyne*, but differs in having the lip clawed. However, the scape is slender, and few flowered. Sepals are keeled with oblique base, free ; petals are subequal, free, also with oblique base, lanceolate ; lip narrow and as long as the sepals ; claw sigmoid, column slender, erect and slightly two-winged above.

Panisea parviflora Lindl. Fol. Orch. 1,1854 ; F.B.I. 5 : 783, 1890 ; King & Pantl. 142, t. 197, 1898 ; Hara, 447, 1966 ; *Panisea demissa* (D. Don) Pftz. in Engl. Pfreich. Orch-Coelog. 141, 1907 ; *Dendrobium demissa* D. Don, Prodr. Fl. Nep. 34, 1825 ; *Coelogyne parviflora* Lindl. Gen. et Spec. Orch. 44, 1830.

Flowers white ; dorsal sepal linear-oblong, lateral sepals membraneous, lanceolate, 5-nerved, petals ovate-lanceolate, 3-nerved, base slightly gibbous ; lip subacute, tip of claw tuberculate, column brownish. *Flowering* during October and November ; distributed between 1,500 to 2,250 metres. Collected from Mulkharka, Sundarijal and Godavari.

(*to be continued*)

Foraminifera of the Gulf of Cambay

BY

K. KAMESWARA RAO,

National Institute of Oceanography, Bombay

(*With* 31 *figures in three plates*)

INTRODUCTION

Noteworthy contributions to the study of Foraminifera in Indian Ocean are based on reports of the 'Challenger' expedition (Brady 1884) and 'Siboga' expedition (Hofker 1927, 1930). Chapman (1895) studied foraminiferan collections of the 'Investigator' off Laccadives from the Arabian Sea. The earliest work on Foraminifera of the Indian Ocean is that of Moebius (1880) from the island of Mauritius. Stubbings (1939) gave an account of Foraminifera of the Arabian Sea based on collections of the John Murray Expedition. Carter (1880), Dakin (1906) and Gnanamuthu (1943) reported on the Foraminifera of the Gulf of Mannar. Ganapati & Satyavati (1958) studied Foraminifera from Bay of Bengal and Sethulekshmi Amma (1958) from Arabian Sea off the coast of Travancore. However, vast regions remain unexplored and our knowledge of the recent Foraminifera of the Indian coasts is therefore still incomplete. The present paper gives the first contribution to the knowledge of Foraminifera in Gulf of Cambay describing 84 species belonging to 34 genera and 15 families. The classification followed is essentially that adopted by Cushman (1948).

DESCRIPTION OF AREA AND LOCATION OF STATIONS

The Gulf of Cambay lies in the Arabian Sea to the north of Bombay between latitudes 20° 30′ and 22° 20′ N. The Gulf is shallow with an average depth of 10-15 fathoms. In the interior of the Gulf there is a small island (Piram) off Gogha and further north a series of submerged banks running parallel to the coast line and exposed during low tide. Sediment samples were dredged during one of the cruises of National Institute of Oceanography, India on I.N.S. 'Darshak' in the month of April 1966 from Stations A to D, the locations of which and the nature of sediment therein are detailed below.

Station A.—Position: 20°35′ N. 71°44′E.
Depth : 21·9 metres. Sediment : muddy sand.

Station B.—Position : 21° 29·5′ N. 72° 25·4′ E.
Depth : 31·1 metres. Sediment : Mud.

Station C.—Position : 21° 26·3′ N. 72° 19·6′E.
Depth : 25·6 metres. Sediment : Sandy mud.

Station D.—Position : 21° 24·2′ N. 72° 26·7′E.
Depth : 27·4 metres. Sediment : Mud.

SYSTEMATICS

Family ASTRORHIZIDAE

Genus *Rhabdammina* M. Sars 1869

Rhabdammina abyssorum W. B. Carpenter (Fig. 1)

Rhabdammina abyssorum Brady 1884, vol. 9, p. 366, pl. 21, figs. 1, 13 ; Cushman, 1910, 71(1), figs. 8-10, p. 24 ; Sethulekshmi Amma, 1958, p. 61, pl. 3, fig. 94 ; Ganapati & Satyavati, 1958, p. 105, pl. 1, figs. 1, 2.

Description : Test has a central chamber with three arms radiating from the centre. Wall arenaceous. Aperture single at the terminal end of each arm.

Length : 0·31 mm.

Locality : Station C.

Distribution : Atlantic, North and South Pacific, Arctic, British Isles and Indian Seas.

Family TEXTULARIIDAE

Subfamily Textulariinæ

Genus *Bigenerina* d'Orbigny 1826

Bigenerina cylindrica Cushman (Fig. 2)

Bigenerina digitata Brady, 1884, vol. 9, p. 370, pl. 44, figs. 19-24 ; Cushman, 1911, 71 (2), p. 28, figs. 49 a, b ; *Bigenerina cylindrica* Cushman, 1922, 104 (3), p. 26, pl. 3, figs. 7, 8 ; Sethulekshmi Amma, 1958, p. 38, pl. 2, fig. 54.

Description : Test cylindrical in shape, slightly compressed with many chambers, early formed chambers biserial, later formed chambers uniserial, wall smooth and finely punctate. Aperture round situated at the centre of oral end of last chamber.

Length : 0·50 mm.

Locality : Station A.

Distribution : North Pacific, Coasts of Japan, North Atlantic, British Isles, West coast of Ireland, Denmark, Adriatic, Mediterranean, and Arabian Sea.

Genus *Textularia* Defrance 1824

Textularia cuneiformis d'Orbigny (Fig. 3)

Textularia cuneiformis Williamson, 1858, p. 75, figs. 158, 159; Sethulekshmi Amma, 1958, p. 39, pl. 2, fig. 56.

Description : Test cone-shaped, much compressed. Later formed chambers very large in size. Sutures depressed. Wall arenaceous. Aperture slit-like at the inner margin of last chamber.

Length : 0·20 mm.

Locality : Station C.

Distribution : British Isles and Arabian Sea.

Textularia agglutinans d'Orbigny, var. **fistula** Cushman (Fig. 4)

Textularia agglutinans d'Orbigny, var. *fistula* Cushman, 1911, 71 (2), p. 10, text-fig. 11. *Textularia agglutinans* d'Orbigny, var. *fistulosa* Sethulekshmi Amma, 1958, p. 40, pl. 2, fig. 58.

Description : Test triangular in lateral aspect, elongate with many chambers, the chambers having fistulose projections, more conspicuous in early chambers than in later chambers. Later chambers somewhat inflated. Sutures depressed and distinct. Aperture slit-like at the inner edge of last chamber.

Length : 0·37 mm.

Locality : Station A.

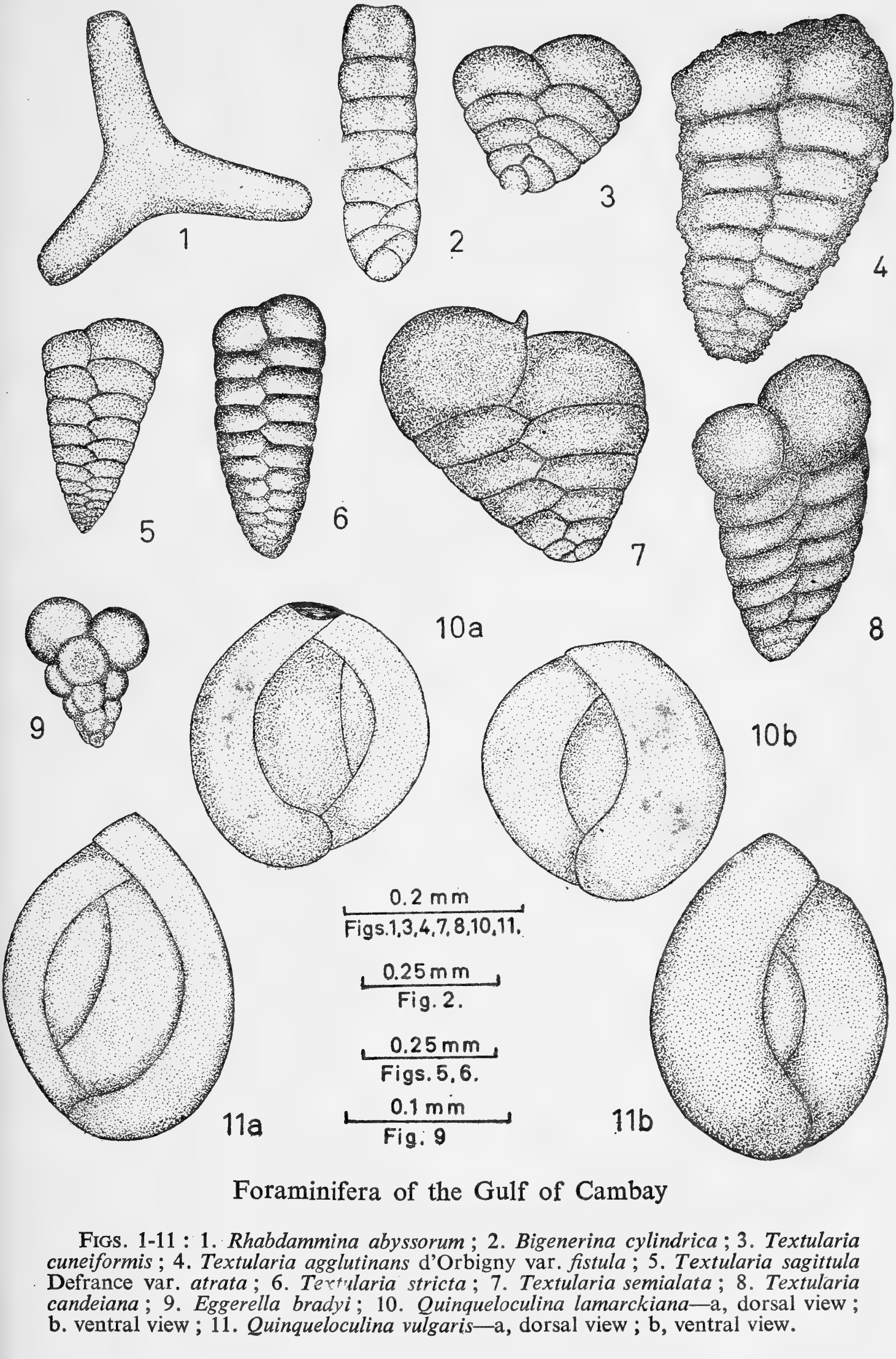
Distribution : North Pacific, Hawaiian Islands, Blake Reef, Vincennes Strait, Southern Japan and Arabian Sea.

Textularia sagittula Defrance var. **atrata** Cushman (Fig. 5)

Textularia sagittula Defrance var. *atrata* Cushman, 1911, 71 (2), p. 7, text-figs. 2-5; Sethulekshmi Amma, 1958, p. 42, pl. 2, fig. 63.

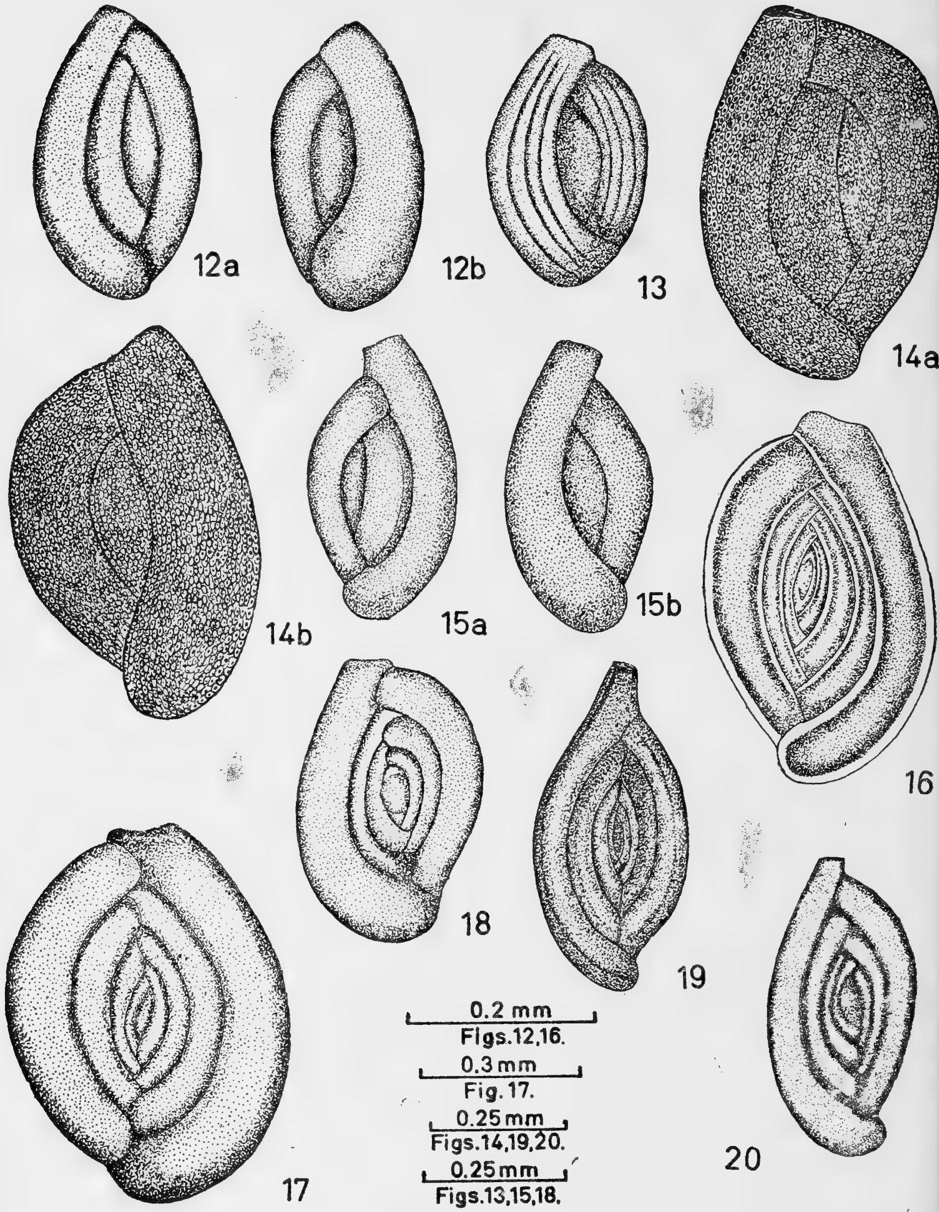
Description : Test triangular in side view, longer than broad, with numerous rectangular chambers, sutures covered by a dark material, texture rough, wall slightly thick. Aperture slit-like on the inner wall of last chamber.

Kameswara Rao : Foraminifera



Foraminifera of the Gulf of Cambay

FIGS. 1-11 : 1. *Rhabdammina abyssorum* ; 2. *Bigenerina cylindrica* ; 3. *Textularia cuneiformis* ; 4. *Textularia agglutinans* d'Orbigny var. *fistula* ; 5. *Textularia sagittula* Defrance var. *atrata* ; 6. *Textularia stricta* ; 7. *Textularia semialata* ; 8. *Textularia candeiana* ; 9. *Eggerella bradyi* ; 10. *Quinqueloculina lamarckiana*—a, dorsal view ; b. ventral view ; 11. *Quinqueloculina vulgaris*—a, dorsal view ; b, ventral view.



Foraminifera of the Gulf of Cambay

FIGS. 12-20 : 12. *Quinqueloculina seminulum*—a, dorsal view ; b, ventral view ; 13. *Quinqueloculina boueana* ; 14. *Quinqueloculina reticulata*—a, dorsal view ; b, ventral view ; 15. *Quinqueloculina candeiana*—a, dorsal view ; b, ventral view ; 16. *Spiroloculina depressa* ; 17. *Spiroloculina depressa* var. *rotundata* ; 18. *Spiroloculina planulata ;* 19. *Spiroloculina grateloupi* ; 20. *Spiroloculina antillatrum* d'Orbigny *aequa*.

Length : 0·38 mm.

Locality : Station A.

Distribution : North Pacific, Eastern Channel of Korean Strait, and Arabian Sea.

Textularia stricta Cushman (Fig. 6)

Textularia stricta Cushman, 1911, 71(2), p. 11, text-figs. 13 a, b; Sethulekshmi Amma, 1958, p. 42, pl. 2. fig. 64.

Description : Test elongate, straight, many chambered, later formed chambers slightly inflated. Periphery lobulated. Sutures slightly depressed. Wall smooth and arenaceous. Aperture an elongate slit at the base of last formed chamber.

Length : 0·47 mm.

Locality : Station A.

Distribution : North Pacific, Eastern Sea off South Western Japan, and Arabian Sea.

Textularia semialata Cushman (Fig. 7)

Textularia semialata Cushman, 1921, 100, vol. 4, p. 116, pl. 24, figs. 2, 3; Cushman, 1932, 161(1), p. 9, pl. 2, figs. 1-3.

Description : Test triangular and compressed, peripheral margin rounded, chambers numerous, later formed chambers near the apertural end inflated. Sutures depressed and distinct. Wall smooth and finely arenaceous. Aperture at the inner wall of last chamber with a prominent raised lip.

Length : 0·31 mm.

Locality : Station C.

Distribution : Tropical Pacific, Philippines, Mokaujar Anchorage, Fiji, off Marokau Island, Paumotus (Tuamotu Archipelago), and Arabian Sea.

Textularia candeiana d'Orbigny (Fig. 8)

Textularia candeiana Cushman, 1911, 71 (2), p. 12, text-figs. 14-17; Heron-Allen & Earland, 1915, vol. 20, pt. 2, p. 627, pl. 47, figs. 10-16; Cushman, 1921, 100, vol. 4, p. 109.

Description : Test elongate, club-shaped, tapering, many chambered, early chambers compressed, later formed chambers highly inflated.

Sutures slightly depressed and distinct. Texture rough, wall arenaceous. Aperture situated in a slight depression on the inner edge of last chamber.

Length : 0·32 mm.

Locality : Station C.

Distribution : Pacific, West Indies, Hawaiian Islands, and Arabian Sea.

Family VALVULINIDAE

Subfamily Eggerellinae

Genus *Eggerella* Cushman 1937

Eggerella bradyi (Cushman) (Fig. 9)

Verneuilina pygmoea Brady, 1884, vol. 9, p. 385, pl. 47, figs. 4-7 ; Chapman, 1895, p. 19 ; Cushman, 1922, 104 (3), p. 59, pl. 11, fig. 1 ; *Eggerella bradyi* Cushman, 1937, No. 8[1], p. 52, pl. 5, fig. 19 ; Sethulekshmi Amma, 1958, p. 36, pl. 2, fig. 52.

Description : Test in the form of a cone with triserially set chambers ; chambers towards the apertural end large in size. Wall smooth and translucent. Aperture a long curved slit at the inner margin of ultimate chamber.

Length : 0·10 mm.

Locality : Station B.

Distribution : Atlantic, Pacific, Arctic, Antarctic, Gulf of Mexico, Caribbean sea, Malay Archipelago, off Japan, British Isles and Arabian Sea.

Family MILIOLIDAE

Subfamily Miliolinae

Genus *Quinqueloculina* d'Orbigny 1826

Quinqueloculina lamarckiana d'Orbigny (Fig. 10 a, b)

Quinqueloculina lamarckiana Cushman, 1929, 104(6), p. 26, pl. 2, figs. 6 a-c ; Cushman, 1932, 161(1), p. 24, pl. 6, figs. 2 a-c ; Ganapati & Satyavati, 1958, p. 106, pl. 1, figs. 21, 22, 23.

Description : Test nearly oval in outline, apertural view triangular, chambers half a coil in length, peripheral margin subacute, sutures well marked, last formed chamber with a short neck. Aperture round with a single long tooth.

[1]Cushman Lab. Foram. Res., Special Publ.

Length : 0·32 mm.

Locality : Station A.

Distribution : Atlantic, Indo-Pacific region, Fiji Islands, Tonga Islands, Sibuko Bay, Borneo, Molluca Sea, Buton Strait, Bay of Bengal and Arabian Sea.

Quinqueloculina vulgaris d'Orbigny (Fig. 11 a, b)

Quinqueloculina vulgaris Cushman, 1917, 71(6), p. 46, pl. 11, fig. 3; Sethulekshmi Amma, 1958, p. 4, pl. 1, fig. 5; Ganapati & Satyavati, 1958, p. 106, pl. 1, figs. 24, 25, 26.

Description : Test short and stoutly built, the apertural view orbicular, peripheral margin rounded, sutures depressed and distinct, wall smooth and imperforate. Aperture small with a single tooth bifid at apex.

Length : 0·34 mm.

Locality : Station A.

Distribution : North Pacific, Hawaiian Islands, off Midway Islands, Guam, Japan, Kerimba Archipelago, Philippines and Indian Seas.

Quinqueloculina seminulum (Linnaeus) (Fig. 12 a, b)

Miliolina seminulum Williamson, 1858, p. 85, pl. 7, figs. 183-185; Brady, 1884, vol. 9, p. 157, pl. 5, figs. 6 a-c; Dakin, 1906, vol. 5, p. 229. *Quinqueloculina seminulum* Cushman, 1917, 71(6), p. 44, pl. 11, fig. 2; Gnanamuthu, 1943, p. 10, pl. 2, figs. 4 a-f.

Description : Test oval, peripheral margin rounded, chambers half a coil in length, sutures depressed, wall smooth and imperforate. Aperture with a single tooth.

Length : 0·32 mm.

Locality : Station C.

Distribution : Pacific Ocean, Philippines, Honolulu, Hawaiian Islands, Kerimba Archipelago, Ceylon coast, and Indian Seas.

Quinqueloculina boueana d'Orbigny (Fig. 13)

Miliolina boueana Brady, 1884, vol. 9, p. 173; pl. 7, figs. 13 a-c. *Quinqueloculina boueana* Cushman, 1917, 71(6), p. 50, pl. 15, fig. 2; Sethulekshmi Amma, 1958, p. 5, pl. 1, fig. 7.

Description : Test as broad as long with rounded chambers, sutures distinct and depressed, periphery rounded. Surface ornamented with longitudinal costae. Aperture circular with a thickened lip and a simple tooth.

Length : 0.47 mm.

Locality : Station A.

Distribution : North Pacific, Atlantic, Hawaiian Islands, off Guam, Japan, and Arabian Sea.

Quinqueloculina reticulata d'Orbigny (Fig. 14 a, b)

Quinqueloculina reticulata Brady, 1884, vol. 9, p. 177, pl. 9, figs. 2-4 ; Cushman, 1917, 71(6), p. 55, pl. 16, figs. 1-3 ; Daniel, 1949, p. 32, figs. 20, 21, 22.

Description : Test oval in outline, chambers half a coil in length, compactly placed together, sutures distinct, peripheral margin rounded. Wall with numerous slight depressions or reticulations. Aperture in line with the body surface. Test black and lustrous.

Length : 0·72 mm.

Locality : Station A.

Distribution : Indian and Pacific Oceans, Honolulu coral reefs and Hawaiian Islands, Bay of Bengal and Arabian Sea.

Quinqueloculina candeiana d'Orbigny (Fig. 15 a, b)

Quinqueloculina candeiana Cushman, 1929, 104(6), p. 27, pl. 3, figs. 1 a-c.

Description : Test longer than broad being more than twice its breadth in length, chambers half a coil in length and triangular in cross section. Sutures distinct. Peripheral margin with a well marked keel. Surface smooth and polished. Aperture with a simple tooth.

Length : 0·50 mm.

Locality : Station C.

Distribution : Atlantic, West Indian region, and Arabian Sea.

Genus *Spiroloculina* d'Orbigny 1826

Spiroloculina depressa d'Orbigny (Fig. 16)

Spiroloculina depressa Williamson, 1858, p. 82, pl. 7, fig. 117; *Spiroloculina limbata* Brady, 1884, vol. 9, p. 150, pl. 9, figs. 15-17 ; *Spiroloculina depressa* Cushman, 1917, 71(6), p. 29, pl. 3, figs. 6-10 ; Sethulekshmi Amma, 1958, p. 2, pl. 1, fig. 1.

Description : Test elliptical with both faces concave. Chambers numerous, sigmoid and square in cross section with projecting ridges at the outer margins. Sutures distinct. Wall calcareous, smooth and porcellaneous. Apertural end more or less in line with the body of the test with a short neck ; aperture round with a single tooth bifid at the tip.

Length : 0·40 mm.

Locality : Station A.

Distribution : North Pacific, Hawaiian Islands, off Japan, Mediterranean, Red Sea, and Indian Seas.

Spiroloculina depressa var. **rotundata** Williamson. (Fig. 17)

Spiroloculina depressa var. *rotundata* Williamson, 1858, p. 82, pl. 7, fig. 178.

Description : Test elliptical, chambers numerous, sigmoid, half a coil in length, round in cross section ; no raised ridges at the outer margins of the chambers. Peripheral margin rounded. Sutures distinct. Wall porcellanoeus and imperforate.

Length : 0·78 mm.

Locality : Station A.

Distribution : British Isles, and Arabian Sea.

Spiroloculina planulata (Lamarck) (Fig. 18)

Spiroloculina planulata Cushman, 1929, 104(6), p. 41, pl. 8, figs. 2-5.

Description : Test unsymmetrical and elliptical in shape. Of the later formed chambers, the initial end of the chamber projects beyond the aperture of the previously formed one. Apertural end of the ultimate chamber slightly projecting. Sutures well marked. Surface not smooth and somewhat matt. Aperture with a single tooth bifid at the tip.

Length : 0·42 mm.

Locality : Station C.

Distribution : European coasts, British Isles, Western Atlantic, Mediterranean and Indo-Pacific region.

Spiroloculina grateloupi d'Orbigny (Fig. 19)

Spiroloculina excavata Brady (not d'Orbigny), 1884, vol. 9, p. 151, pl. 9, figs. 5, 6. *Spiroloculina grateloupi* Cushman, 1917, 71(6), p. 31, pl. 4, figs. 4, 5; Cushman, 1929, 104 (6), p. 40, pl. 8, figs. 1, a, b ; Gnanamuthu, 1943, p. 9, pl. 2, fig. 2.

Description : Test oval in shape with central portion excavated, chambers numerous, half a coil in length ; chambers increasing in size as added. Periphery convex. Sutures distinct. Wall slightly rough in texture. Aperture with a single bifid tooth.

Length : 0·38 mm.

Locality : Station A.

Distribution : Indo-Pacific region, Kerimba Archipelago, and Philippines.

Spiroloculina antillatrum d'Orbigny **aequa** Cushman (Fig. 20)

Spiroloculina antillatrum d'Orbigny *aequa* Cushman, 1932, 161(1), p. 38, pl. 9, figs. 13 a, b.

Description : Test ovate, longer than broad with the central region depressed on both sides, chambers few in number, peripheral edge rounded, sutures distinct, proloculum spherical and the last formed chamber projecting a little beyond the body of the test at both ends ; projection at the apertural end neck-like. Aperture round with a single tooth. Wall calcareous, porcellaneous and smooth.

Length : 0·55 mm.

Locality : Station A.

Distribution : Tropical Pacific Ocean, and Arabian Sea.

Genus *Triloculina* d'Orbigny 1826

Triloculina trigonula (Lamarck) (Fig. 21 a, b)

Miliolina trigonula Williamson, 1858, p. 83, pl. 7, figs. 180-182 ; Brady, 1884, vol. 9, p. 164, pl. 3, figs. 14-16. *Triloculina trigonula* Cushman, 1917, 71(6), p. 65, pl. 25, fig. 3 ; Daniel, 1949, p. 47, figs. 47, 48.

Description : Test with three visible chambers, longer than broad, in end view triangular, periphery rounded and convex, angles of chambers rounded, chambers somewhat inflated. Aperture in line with body of test and with a single tooth.

Length : 0·27 mm.

Locality : Station C.

Distribution : North Pacific, Honolulu, Hawaiian Islands, off Japan, Gulf of Mannar off Krusadai, and Arabian Sea.

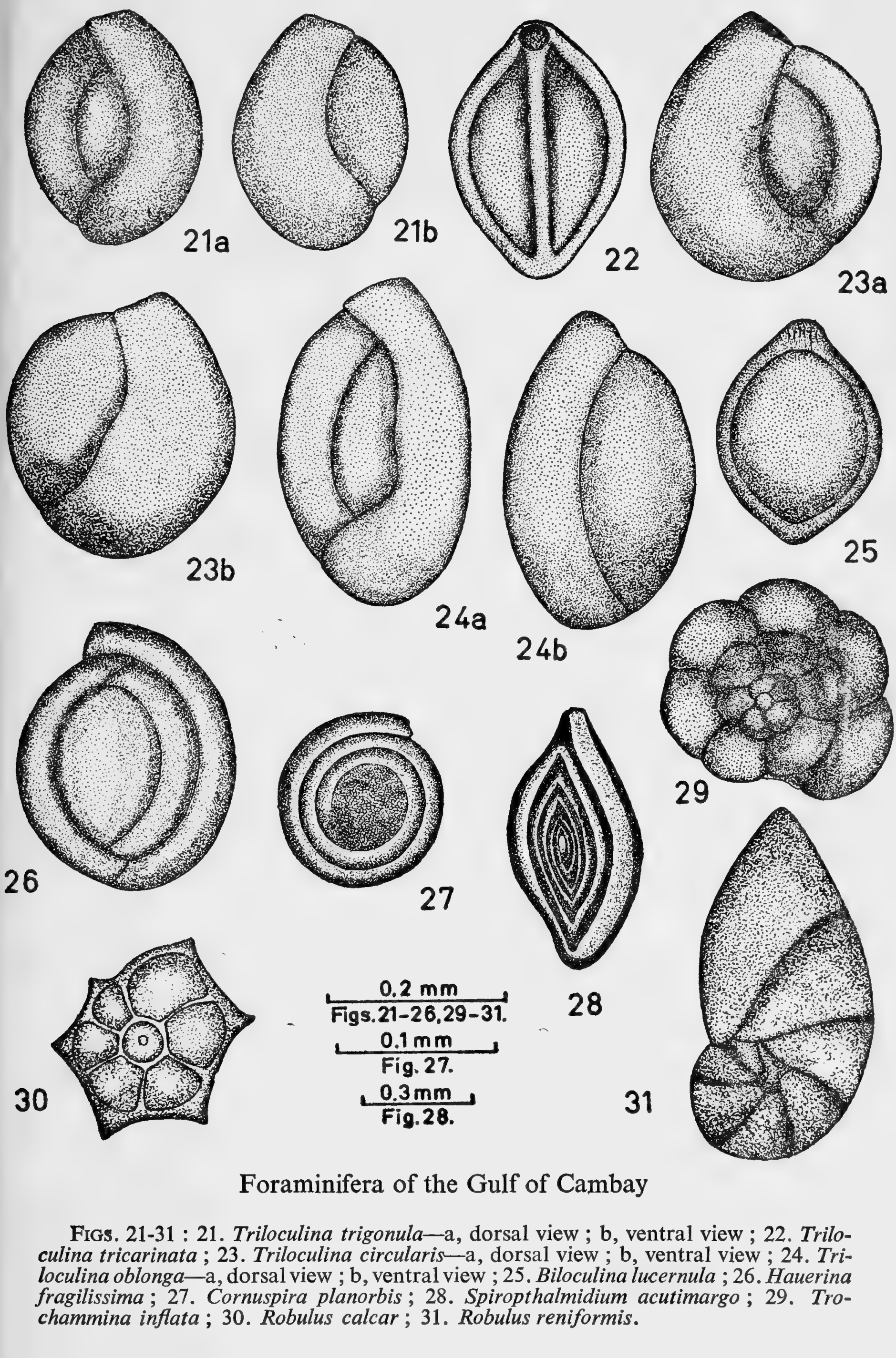
Triloculina tricarinata (d'Orbigny) (Fig. 22)

Triloculina tricarinata Brady, 1884, vol. 9, p. 165, pl. 3, figs. 17 a, b ; Cushman 1917, 71(6), p. 66, pl. 25, figs. 1, 2 ; Ganapati & Satyavati, 1958, p. 106, pl. 2, fig. 38 ; Sethulekshmi Amma, 1958, p. 8, pl. 1, fig. 12.

Description : Test of three chambers, in end view triangular, angles of chambers acute. Aperture with a single bifid tooth.

Kameswara Rao : Foraminifera

Plate III



Foraminifera of the Gulf of Cambay

Figs. 21-31 : 21. *Triloculina trigonula*—a, dorsal view ; b, ventral view ; 22. *Triloculina tricarinata* ; 23. *Triloculina circularis*—a, dorsal view ; b, ventral view ; 24. *Triloculina oblonga*—a, dorsal view ; b, ventral view ; 25. *Biloculina lucernula* ; 26. *Hauerina fragilissima* ; 27. *Cornuspira planorbis* ; 28. *Spiropthalmidium acutimargo* ; 29. *Trochammina inflata* ; 30. *Robulus calcar* ; 31. *Robulus reniformis*.

Length : 0·30 mm.

Locality : Station A.

Distribution : North Pacific, Hawaiian Islands, Midway Island, Guam, off Japan, Ceylon coast and Indian seas.

Triloculina circularis (Bornemann) (Fig. 23 a, b)

Miliolina circularis Brady, 1884, vol. 9, p. 169, pl. 4, fig. 3, pl. 5, figs. 13, 14 ; Dakin, 1906, vol. 5, p. 229. *Triloculina circularis* Cushman, 1917, 71(6), p. 67, pl. 25, fig. 4, pl. 26, fig. 1 ; Cushman, 1929, 104 (6), p. 58, pl. 13, figs. 6, 7, pl. 14, figs. 1, 2 ; Daniel, 1949, p. 48, figs. 105, 106 ; Sethulekshmi Amma, 1958, p. 7, pl. 1, fig. 10.

Description : Test circular with three inflated round chambers, sutures distinct. Peripheral margin rounded. Aperture flush with body of test and with a single semicircular tooth.

Length : 0·31 mm.

Locality : Station C.

Distribution : North Pacific, off Western coast of Tropical America, off Alaska, Hawaiian Islands, Galapagos, off Japan, Ceylon coast of Gulf of Mannar and Indian seas.

Triloculina oblonga (Montagu) (Fig. 24 a, b)

Miliolina oblonga Brady, 1884, vol. 9, p. 160, pl. 5, fig. 4 a, b ; Dakin, 1906, vol. 5, p. 230. *Triloculina oblonga* Cushman, 1917, 71(6), p. 69, pl. 26, fig. 3 ; Daniel, 1949, p. 49, figs. 49, 50, 51 ; Sethulekshmi Amma, 1958, p. 6, pl. 1, fig. 9.

Description : Test oval in outline with three chambers, peripheral margin rounded, sutures depressed, last chamber longer than others. Wall smooth. Aperture oval and strongly lipped.

Length : 0·40 mm.

Locality : Station A.

Distribution : North Pacific, Atlantic and Indian ocean, Hawaiian Islands, Manila Bay, Philippine Islands, Gulf of Mannar, and Arabian Sea.

Genus *Biloculina* d'Orbigny 1826

Biloculina lucernula Schwager (Fig. 25)

Biloculina bulloides Brady, 1884, vol. 9, p. 142, pl. 2, figs. 5, 6; *Biloculina tubulosa* Brady, 1884, vol. 9, p. 147, pl. 3, figs. 6, 14. *Biloculina bulloides* Chapman, 1907, vol. 30, p. 13 ; Bagg, 1908, vol. 34, p. 117. *Biloculina lucernula* Cushman, 1917, 71(6), p. 79, pl. 32, fig. 2.

Description : Test subglobular, apertural end and aboral end slightly produced, periphery subacute. Wall thick, surface rough. Aperture circular and terminal.

Length : 0·23 mm.

Locality : Station A.

Distribution : South Pacific and South Atlantic, Western coast of America, off the coast of Oregon, Hawaiian Islands, between Guam and Japan, and Arabian Sea.

Subfamily Haueringinae

Genus *Hauerina* d'Orbigny 1839

Hauerina fragilissima (H. B. Brady) (Fig. 26)

Spiroloculina fragilissima Brady, 1884, vol. 9, p. 149, pl. 9, figs. 12-14 ; Heron-Allen & Earland, 1915, vol. 20, p. 587, pl. 46, figs. 1, 2. *Hauerina fragilissima* Cushman, 1917, 71(6), p. 64, pl. 24, fig. 4 ; Cushman, 1921, 100, vol. 4, p. 451 ; Cushman, 1932, 161(1), p. 42, pl. 10, fig. 9 ; Sethulekshmi Amma, 1958, p. 11, pl. 1, fig. 18.

Description : Test somewhat circular, chambers numerous, half a coil in length, early chambers quinqueloculine, later ones spiroloculine. Peripheral margin rounded, sutures slightly depressed and distinct. Wall thin and translucent. Aperture broken or cribrate.

Length : 0·19 mm.

Locality : Station B.

Distribution : Indo-Pacific region, Kerimba Archipelago, Malay Archipelago, and Gulf of Mannar off Ceylon coast.

Family Opthalmidiidae

Subfamily Cornuspirinae

Genus *Cornuspira* Schultze 1854

Cornuspira planorbis Schultze (Fig. 27)

Cornuspira planorbis Cushman, 1959, p. 189, pl. 16, fig. 1. Gnanamuthu, 1943, p. 14, pl. 3, fig. 13.

Description : Test planispiral with a proloculum followed by a second unsegmented tube. Wall calcareous, smooth and imperforate. Aperture situated at the end of tube.

Diameter : 0·12 mm.

Locality : Station A.

Distribution : Arctic and North temperate zones, Gulf of Mannar off Krusadai, and Arabian Sea.

Subfamily Ophthalmidiinae

Genus *Spirophthalmidium* Cushman 1927

Spirophthalmidium acutimargo H. B. Brady (Fig. 28)

Spiroloculina acutimargo Brady (part), 1884, vol. 9, p. 154, pl. 10, fig. 13 ; Heron-Allen & Earland, 1915, vol. 20, p. 557 ; Cushman, 1917, 71(6), p. 31, pl. 5, fig. 1. *Spirophthalmidium acutimargo* Ganapati & Satyavati 1958, p. 107, pl. 2, fig. 51.

Description : Test oval, large in size and compressed. The primordial chamber followed by a second tube like chamber which is planispirally coiled and unsegmented. There is clear shell material between the chambers, later chambers half a coil in length, periphery carinate. Wall calcareous and smooth. Aperture round formed by the opening of the last chamber.

Length : 0·80 mm.

Locality : Station A.

Distribution : South Atlantic, North and South Pacific off Hawaiian Islands, off Bermuda, Madagascar, and Indian Seas.

Family TROCHAMMINIDAE

Subfamily Trochammininae

Genus *Trochammina* Parker and Jones 1859

Trochammina inflata (Montagu) (Fig. 29)

Trochammina inflata Brady, 1884, vol. 9, p. 338, pl. 41, figs. 4 a-c ; Cushman, 1910, 71 (1), p. 121, figs. 188, a, b ; Cushman, 1920, 104 (2), p. 73 ; Sethulekshmi Amma, 1958, p. 62, pl. 3, fig. 95.

Description : Test a trochoid spire with numerous chambers, the later formed chambers larger in size. All chambers visible on the dorsal side but only those of the last whorl about six chambers on the ventral side, test concave on the ventral side with a deep umbilicus. Sutures somewhat deep and distinct, peripheral margin lobulated. Aperture an arched slit lying ventrally on ultimate chamber near to the previous convolution and slightly within the periphery.

Diameter : 0·28 mm.

Locality : Station A.

Distribution : North Pacific, off Japan, Atlantic, British Isles, Coast of Spain, Gulf of Mexico and eastern Coast of United States, and Arabian Sea.

Family LAGENIDAE

Subfamily Nodosariinae

Genus *Robulus* Montfort 1808

Robulus calcar (Linnaeus) (Fig. 30)

Cristellaria calcar Brady (part), 1884, vol. 9, p. 551, pl. 70, figs. 9-12 ; Brady, Parker & Jones, 1888, vol. 12, p. 224, pl. 44, fig. 14 ; Cushman, 1913, 71(3), p. 72, pl. 32, fig. 4 ; *Robulus calcar* Cushman, 1929, vol. 5[1], p. 84, pl. 12, fig. 18 ; Cushman, 1933, 161(2), pl. 2, p. 7, figs. 3a, b ; Ganapati & Satyavati, 1958, p. 107, pl. 3, fig. 63.

Description : Test biconvex with few chambers, the final whorl of five to seven chambers. Peripheral margin of each chamber drawn into a spine situated at the middle of chamber. Sutures limbate. Wall smooth and finely foraminated. Aperture radiate situated below on the apertural face of last chamber.

Diameter : 0·21 mm.

Locality : Station C.

Distribution : Widely distributed in many seas.

Robulus reniformis (d'Orbigny) (Fig. 31)

Robulus reniformis Cushman, 1933, No. 161(2), p. 2, pl. 1, figs. 2 and 3.

Description : Test triangular from lateral aspect, compressed with planispirally set chambers, eight chambers in the final coil. Sutures limbate, surface smooth. Aperture at the end of last chamber.

Length : 0·25 mm.

Locality : Station C.

Distribution : Tropical Pacific Ocean and Indian Seas.

(*to be continued*)

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[1] Contr. Cushman Lab. Foram. Res.

Obituary

S. B. SETNA

(1895-1969)

I have to record with regret the passing away of Dr. S. B. Setna on September 29, 1969. One of the stalwarts in fisheries development in India, he was, at the time of his death, the Managing Director of New India Fisheries, an Indo-Japanese concern in Bombay. As the first Director of Fisheries from 1945 to 1954 of the old Bombay State he had established the department from scratch and nurtured it into a growing organisation.

He was born on June 1, 1895, at Lahore. A keen sportsman, he graduated from Lahore College of the Punjab University and took his doctorate from Cambridge University. After his return to India he worked as a lecturer in Zoology at the then Royal Institute of Science and joined the Industries Department of Government of Bombay as a Fisheries Officer in November 1933. In those days, fishermen were almost ignored and fisheries development was not considered very important. However, Dr. Setna set as his first task the improvement of fish supply to Bombay City. For this purpose, he persuaded businessmen to introduce fast moving launches for bringing the abundant supplies of mackerel and sardines from the North Canara coast (now in Mysore State) to the thriving markets of Bombay.

Dr. Setna's second achievement as Director of Fisheries was introduction of mechanization of indigenous fishing craft. Persuading illiterate and conservative fishermen to install diesel engines on their wooden boats was not an easy one, but he succeeded in introducing the first mechanized fishing vessel in 1948-49. By the time he retired in 1954, the number of mechanized vessels in the State rose to 250, as against only a few in other States. His third outstanding achievement was the establishment of the Taraporewala Aquarium and Marine Biological Research Station.

He was deputed to U.S.A. in 1949 and again in 1953 when he visited England, Japan, Norway, also to study fishery development in those countries and methods to modernise our industry. In this effort, he secured substantial assistance from the U.S. Government (Technical Co-operation Mission) for development in different sectors. In 1954, he was awarded Chandrakala Hora Gold medal for his outstanding contribution to Fisheries Development in India.

Dr. Setna was a jovial optimist and was even tempered even in difficult situations. He encouraged his assistants to take up fisheries research and development in different sectors and built up healthy traditions in the department. This has been an invaluable legacy.

After his retirement, he again visited Japan and organised a technical collaboration in commercial fisheries with one of the top fishing concerns of the world, namely the Taiyo Fishing Company, and established the first successful fishery enterprise in India, namely the New India Fisheries Ltd. of which he continued to be the Managing Director. He developed this organisation as one of the largest fishing complex in India to-date.

Exploratory trawling has been tried in India by different States as well as the Government of India since 1908 but without much commercial success. With the help of the Japanese collaborators, bull-trawling was conducted by the firm which proved commercially successful.

He was 74 years of age when he passed away but he was working till his last day. His indefatigable energy and sincerity of purpose has been a source of great inspiration. He had vast practical experience and keen insight of the requirements of Fisheries Development in India.

He was a member of several scientific organisations including Indian Science Congress, National Institute of Sciences, Zoological Society of India, etc. He served on the executive committee of the Bombay Natural History Society and was an editor of the Journal.

C. V. KULKARNI

Reviews

1. THE INVIOLABLE HILLS: THE ECOLOGY, CONSERVATION AND REGENERATION OF THE BRITISH UPLANDS. By Robert A. de J. Hart. pp. xix+244 (22×13 cm.). London, 1968. Stuart and Watkins *in conjunction with* The Soil Association. Price 42*s*. 6*d*. net.

I wish I could recommend this book without reservation. Its aims are so commendable—conservation, the importance of trees, a plea for biological instead of chemical control, a better understanding of ecological relationships so that biotopes are not destroyed and national resources are fully utilised. The author is obviously very well qualified for the task and has collected considerable relevant material on the subject. Then, why must he mix scientific fact with a liberal sprinkling of what can only be described as folklore ?

For example, what is one to make of this statement ? ' An animal or plant which has been allowed to develop its innate resources and potentialities to the full has the power within itself to overcome diseases and even pests.' Now, though healthy organisms are more resistant in general than unhealthy ones, healthy individuals do nevertheless succumb to disease. This sentence mars the rest of the paragraph, which makes the quite unexceptionable point that diseases and pests generally get out of hand because natural checks have been removed, often through human interference.

And, another example: ' Genuinely sun-dried raisins are said to contain more iron than fresh grapes, and the Hunzas . . ., who are said to be positively and absolutely the fittest race in the world, consume large quantities of their own sun-dried apricots . . .'.

Again, France is supposed to have survived three invasions in seventy years because many white collar workers as well as peasants have roots in the soil. The example of Bosquet, a machine tool worker, is quoted. He and his family simply ' dug in ' on their land during the German occupation and grew their own food, and were therefore mentally and physically fit to start again ' when the storm blew over '. One cannot help pointing out that many people, in France and elsewhere, were mentally and physically unfit, or even dead, at the end of the war through having *actively* done something to make the ' storm ' blow over.

R. R.

2. S.O.S. RHINO. By C. A. W. Guggisberg. pp. 174 (21·5 × 17 cm.), with one coloured and eight black-and-white plates and six figures. London, 1966. Andre Deutsch Limited. Price 27*s.* 6*d.* net.

In a brief foreword by Collin Willock, Editor of the series ' Survival Books ', of which S.O.S. RHINO is the 7th Volume, we are told that the author is a distinguished naturalist with an affection for the Rhino and the good fortune to be actually living in Kenya's Rhino country.

As appears from the title, the book concerns itself in particular with the survival aspect of the Rhino and surveys separately and at length the ups and downs in population and the present status of the animals in each area of Africa and Asia where they survive. The writer, it appears is aquainted at first hand with all these places. To the professional making a study of the survival problem this comprehensive and detailed information would be invaluable, but in the absence of any elaborate maps the lay reader unfamiliar with Africa is likely to see a somewhat disconnected picture of the status of the two species of Rhino in that vast subcontinent.

A very interesting chapter gives a synopsis of the 160 million year history of this very ancient family of mammals and another fascinating chapter reviews the rhino's relation of man from prehistoric times to the present. It is a relationship which has been singularly unfortunate for the archaic pachyderm whose early forbears flourished over most of the world. There have been many branches and numerous species of the family widely varying in size and shape, amongst which was possibly the largest land mammal, the Baluchitherium which stood 18 ft. high and was 28 ft. long. The comparatively few species of this huge family that emerged into recent ages might have prospered, confident in their massive bulk, armoured hide and formidable horn. But man, as we see from his cave paintings, started hunting the Rhino from early prehistoric times. Its very bulk made it an attractive prize and its armoured hide was no proof against inventors genius of that meat hungry hunter. And now we view the strange irony of this harassed monster pushed to the verge of final defeat by its main defence, its horn. The claim that the horn is aphrodisiac is just one of the fantastic legends and wild beliefs about the animal which have persisted right up to modern times.

The 5 surviving species, 2 in Africa and 3 in Asia, are treated in separate sections. We get a wealth of information based on first hand knowledge and illustrated by excellent photographs by the author about the life and habits of the animals. There is a chapter containing the authors intermittent observations of individual animals and individual families in the Amboseli Reserve covering a period of 10 years. The detailed description of all aspects of behaviour, much of it unpredictable makes very interesting reading and incidentally illustrates the danger of drawing wide generalisations about a species based on restricted observation.

D. J. P.

3. THE MILLIPEDE *THYROPYGUS* (with special reference to Indian species). C.S.I.R. Zoological Memoir No. 1. By G. Krishnan, pp. 1-84 (25×16 cm.). Preface and 44 illustrations. Published by the Council of Scientific and Industrial Research 1968. Price Rs. 12; 24*s.*; $3.50.

This publication is the first of the series in C.S.I.R. Zoological Memoirs. The subject-matter falls under 17 well-chosen heads preceded by an introduction classifying Diplopoda (millipedes) with reference to the systematic position of *Thyropygus* and listing all the Indian genera of the family Harpagophoridae which includes *Thyropygus*, together with their respective distinguishing characters. Akey for identifying the Indian species of *Thyropygus* is also furnished, which is followed by a short description and distribution of each of the species.

Dr. G. Krishnan, the author, who has done considerable original research on arthropod anatomy, has dealt in detail in this Memoir with the taxonomy, anatomy, reproduction, development and habits of *Thyropygus poseidon*, based mostly on his own observations. In conformity with the modern trends in zoological studies the author has laid emphasis not only on the anatomical organization of the species but also on its ecological and physiological aspects correlated with structure.

The work is adequately and accurately illustrated with black and white line-drawings and most of the illustrations are according to the author, based on the preparations made for this purpose. A bibliography of references and an alphabetical index at the end, enhance the usefulness of the publication, while the chapter on directions for practical work, makes it indispensable both to the teacher and the taught as also a research worker.

A couple of photographic illustrations of the animal in its natural environment, would perhaps have added to the value of the book.

The print is bold and clear and the get-up good. The book is moderately priced too. It is indeed a significant addition to the existing zoological literature and no library should miss it.

V. K. C.

4. TIME IS SHORT AND THE WATER RISES. By John Walsh with Robert Gannon. pp. 224 (24×16 cm.), with 19 colour and 22 monochrome photographs and two maps. London, 1967. Thomas Nelson & Sons Ltd. Price 42*s*. net.

In response to the appeal from Surinam, a Dutch Colony on the North-East shoulder of South America, the Massachusetts S.P.C.A. aided by the International S.P.C.A. sent out two of its men to organise the rescue of thousands of animals marooned on the shrinking islands of a new Hydel Project Lake.

John Walsh who was in charge of field operations from start to finish was an experienced and versatile S.P.C.A. man with experience in handling all sorts of animals, but completely unacquainted with the jungle and animals in the wild. This handicap and the devilishly hostile environment of the Equatorial Rain Forest was overcome by a resourcefulness, enthusiasm and endurance which resulted in the rescue of about 10,000 animals, large and small, from land toads, tortoise, and snakes to deer, tapir and jaguar. An interesting Index gives the specieswise count of rescued animals. Numbers of sloth, Tree Porcupine and Armadillos add up more than half the total.

To help him Walsh collected a team of about 50 Bushnegroes, descendants of African slaves settled along forest rivers. Riverine folk, they had scant knowledge of the jungle and its animals. Subsequently they were joined by a pack of mongrel hunting dogs in charge of a creole and an Indian settler, professional hunters they were the only two to the team versed in jungle-craft. The count of captured animals rose immediately, and one wonders why better expertise was not made available from the start. The learn as you go along method of working would have been avoided.

Rescue operations were characteristically amphibian with a small fleet of dugout canoes usually in attendance. The concentrated animals on shrinking islands were either trapped, or driven by dogs into water from which they were fished out into the waiting boats. When islands were completely submerged, the exposed tree dwelling fauna were shot down with tranquillisers from the defoliating canopy.

The book is written 'with Robert Gannon' presumably a professional writer who translates the factual account into a readable story spread over 16 chapters, not all in chronological sequence. Much of the book is not directly concerned with animals but discourses widely on related topics. The country and its past, the trials and vicissitudes of life at camp are touched upon. Often it lapses into slap-stick farce, not in very good taste, at the expense of the unsophisticated Bushnegro. Then there are racy hair-raising accounts of dangers and near disasters that Walsh and his companions ran into, most of them brought about by inexperience and lack of ordinary caution and forethought.

D. J. P.

5. ORNAMENTAL BULBOUS PLANTS. By S. L. Jindal. pp. xvii+190 (21·5×13·5 cm.). New Delhi, 1968. Indian Council of Agricultural Research. Price Rs. 19.75.

The word ' bulbous ' in this title is used in a comprehensive sense to include all plants with underground stems, whether bulbs properly so-called, corms, tubers, rhizomes, or rootstocks. As the book is intended for ' the amateur gardener ' the author commences by explaining these different terms. The explanation is accompanied by twelve illustrative photographs ; marked diagrams showing on a larger scale the points mentioned in the explanation would have been more helpful. The mention of *Crocus* and *Colchicum* under both 'tuber' and ' corm ' is unfortunate, as it will leave the general reader puzzled as to which of these two forms of stem occurs in these plants. The first chapter which occupies ten printed pages in all ends with general notes on the cultivation and care of bulbous plants, which are supplemented in many cases by special instructions in the sections dealing with particular plants.

The main portion of the book consists of a description of about 300 species under about 80 genus headings. The description is accompanied by 30 full-page illustrations, 24 of them in colour. Among other plants described is *Eichhornia speciosa*, Water Hyacinth. I am surprised to find it spoken of as ' ideal as a floating aquatic ' and recommended for growth along ' shore lines of ponds and lakes '. Having regard to the pest it has proved itself in several parts of India, I would have expected discouragement of its cultivation or, at least, a warning stronger than a mere emphasis on periodical clearing to lessen mosquito breeding and encroachment on growth of ' other aquatic ornamentals '.

The book closes with an appendix in tabular form giving important characteristics of the plants dealt with, including notes on the colour of the inflorescence, the period of flowering, and the site recommended for cultivation.

D. E. R.

6. HONEY BEES FROM CLOSE UP. By Arthur M. Dines. With photographs by Stephen Dalton. pp. 114 (26 × 19 cm.). London, 1968. Cassell & Co. Ltd. Price 35*s*. net.

This fascinating account of the European Honey Bee *Apis mellifera* in all its aspects profusely illustrated with large scale photographs is uniform with L. Hugh Newman's ANTS FROM CLOSE UP published recently by Messrs Cassell & Co., which also is illustrated with photographs by Stephen Dalton. We look forward eagerly to more books of this quality in the series. The tale is told in simple language, using a minimum of technical terms.

One is struck throughout by the utter efficiency with which everything in the life of the honey bee is accomplished : the production of the structural material, the use of it to the best advantage, economy in its use, the location of the cells with strict regard to their use, the sloping of them the better to serve their purpose, the succession of duties for each individual worker keeping pace step by step with changes in her capacity, the organisation of work in the hive, temperature and moisture control in the home, the passing on of information between members of the hive, the timing of the swarming, and so on. It is wonderful to reflect that this is not the result of intelligent planning but something that has been brought about by the slow process of evolution.

It is fairly certain, the author tells us, that *Apis mellifera* originated in South Asia and from thence spread to China, Africa, the Mediterranean countries, and the further parts of Europe almost into the Arctic Circle, adapting itself to local conditions as it spread. With human intervention it has spread to the New World, and has been kept with success there, particularly in the U.S.A. and Canada. In many respects it is better as a gatherer of honey than our domestic bee, *Apis indica.* Attempts to introduce *Apis mellifera* into India go back to the closing years of the last Century. In spite of its Asiatic origin, however, these attempts have been attended with indifferent success. Perhaps with the improved methods of transfer and the quick air-transport now available, and with the advance in our knowledge of bee-keeping, some solution will be found.

D. E. R.

Miscellaneous Notes

1. THE WHITE BISON COUNTRY IN THE PALNI HILLS, MADURAI DISTRICT, SOUTH INDIA

A recent review of south Indian Game Reserves in the *Journal* brought back memories of the many trips that I made to the Talanji-Manjampatti-Kukkal area between the years 1929 and 1937.

I got to know the area very well through a fellow planter from the High Range in Travancore—Ted Rannicar. He had made a number of trips down to Talanji on his own, and had talked about White Bison in the Club. No one believed him. My first trip was with him in 1929. He probably knew the area better than anyone else but he died in Tasmania a few years ago.

Not many people visited the White Bison country in those years. I organised two trips for Mr. & Mrs. Cotton from the Anamallais—they are both now dead, and I organised another trip for John Sweet the D.F.O. of South Coimbatore. I supplied Mr. Ralph Morris with maps and notes for the only trip he made there.

The way into the area was down the Madras bank of the Chinnar River from the Chinnar Customs House, and across this river at a big bend which was not possible if there was much water in the river. Then on down to the Pulayar village of Talanji on the Taen Ar River. There was a ford across the river at the village which could also be very dangerous after heavy rain. From Talanji a track climbed up the hill towards Mudiamallai. In the foothill slopes of this mountain there was, and I hope still is, a large cave under a huge overhanging rock. There were large numbers of wild elephants all over the area, and this cave which had a convenient stream running over the rocks below it, was the only elephant proof camp for many miles around. It was called the Kal Parai. The walls were covered with rock drawings of deer, bison and crude human figures, said to have been done by pilgrims passing through to Madurai. A short climb out of the Kal Parai brought one out on a flat plateau, one side of which fell away into a large, crater-like, area in the middle of which was a much used salt lick. The whole of this area from the slopes of Mudiamallai, right down to the river at Manjampatti, and up the tracks to Kilanavayal in the Kodai Hills, teamed with bison and elephants. It was comparatively open deciduous forest—stunted Teak, Miraballams, Nellikai (*Phyllanthes* sp.), Bamboo and long grass, etc.—except in the river beds where there was thick evergreen growth and huge breaks of giant bamboo. The crater area was full of lantana, It was a NE. Monsoon area and received very good rain then, often right through until January, but the rest of the year was very dry. In the dry weather a lot of the game migrated along well worn migration paths into the Ayyakudi Zamin, leaving behind a much smaller population in the river beds, and on the higher hill slopes.

I counted 120 bison in one huge congregation near the river at Manjampatti one Christmas, and there were always many smaller herds around at this time of year. I never saw a complete herd of white bison. There were light coloured individuals in most herds in the neighbourhood, varying in colour from light red, through the duns to pure white. Most of them were cows or calves, but I knew of two full grown white bulls. I also knew of one herd of some 20 animals in which every animal was of an abnormal colour. They had some religious significance to the local Pulayar as they would try to steer one gently away from any herd with abnormal coloured animals. As far as I know no one ever shot a white bull. Rannicar shot a white cow, and I have a magnificent head of a bull who was almost jet black in body, but had blue eyes and an unusually light coloured head skin. The bison, and probably the deer, suffered a lot from foot and mouth disease brought in by the herds of cattle from the low country which came in every year to graze the Manjampatti area. I have several times come aeross dead bison whose hoofs were in a horrible mess. In the years before about 1936 or 1937 there was no restriction on the shooting of any abnormal coloured animal. But after Mr. Ralph Morris's visit, which I believe was sponsored by the Society, the whole area was, I think, brought into the Palni Hills reserve, and the shooting of abnormal coloured bison was prohibited. Your records will probably show when this happened[1]. I doubt if it was very effective protection as Forest Guards were very scattered, and few sportsmen visited the area. Probably the white bison got their best protection from the refusal of the local Pulayan to guide anyone to them.

At one time there was a considerable area of terraced irrigation between Manjampatti, and the escarpment where the Taen Ar toppels over a rock precipice several thousand feet above. This was extensive and ran around the contours of many hills. It had been abandoned for a very long time probably because of elephants or malaria, or both. There are quite large teak trees growing out of some of the old flats. The Gounders on the hills above still have extensive terraced cultivation and grow barley.

I knew of no other area in south India where elephants were so numerous—not even Mount Stewart in its best days. I was once forced

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[1] In 1932—EDS.

out of a camp on the river at Manjampatti in the dry weather, by a huge herd of elephants who objected strongly to my grass huts being built on their bathing pool. There were always rogue elephants around and some of them could be very nasty. The Pulayars at Talanji had a lot of trouble from elephant raids on their paddy. The Pulayars at Manjampatti, who reckoned themselves superior to the Talanji ones, did not attempt any cultivation.

Apart from bison and elephants there was plenty of other game in the area.

The upper slopes of Mudiamallai had some very fine sambar heads, living amongst the stunted date scrub. There were also Niligiri Tahr on these slopes, and I have seen them in the bamboo right down to 2,000 ft. or so.

There were of course plenty of predators—tiger, panther and wild dog. I never saw a sloth bear on the lower slopes, but I ran into one asleep at about 5,000 ft. on the way down from Kukkul. Surprisingly, I never saw any pig though there was plenty of wild ginger and saffron about.

Both spotted deer and jungle sheep could be found in the bamboo areas, but they were nowhere very numerous. There were a few peacock on the village outskirts, and jungle fowl and spur fowl were fairly numerous. On the higher slopes both the Great and the Grey Hornbill were fairly common. At these elevations a wild mango grew profusely in the ravines.

In the dry weather both elephant and bison could be found up to the edge of the hill cultivation at about 6,000 ft. One other thing that should be mentioned is that the whole area abounds in prehistoric dolmens. The local tribes call them Kal-veedu, or stone houses. They are always in colonies on sheet rock, and each colony is always in sight of other colonies. With a little practice it is fairly easy on any given site to decide where the next colony should be. Some are the simple type of side stones and cap stones, but others are enclosed in rubble walls. On one such site there is a thin vertical shaft in the rock which has fresh water in the bottom. It is still used by the Pulayars. On the lower slopes of Mudiamallai there are signs of an old quarry where huge slabs of granite were quarried by fire. The local Pulayars have no legends attached to the Dolmens, and they are not taboo or surrounded with any form of superstition. In Maricor Village, on the High Range ghat road, the Pulayars used some particularly well preserved ones as dwellings.

The whole area below about 4,000 ft. was very malarious. This no doubts accounts for the smallness of the Pulayar Colony at Manjampatti and for the abandonment of a good deal of fertile cultivation. The village of Talanji was almost wiped out by an epidemic of cholera in the 1920's. Most of the slopes are very steep and are difficult and tiring going.

BAYNARDS MANOR HOUSE,
RUDGWICK, NR. HORSHAM,
SUSSEX, ENGLAND,
October 13, 1969.

JAMES L. H. WILLIAMS

2. TAXONOMIC NOTES ON THE SZECHWAN BURROWING SHREW, *ANOUROSOREX SQUAMIPES* MILNE-EDWARDS, FROM INDIA

While studying a collection of soricids from Assam and NEFA, India, we have come across a good number of specimens of the Szechwan Burrowing Shrew from different localities. Detailed examination, shows that this shrew cannot be placed under *Anourosorex squamipes squamipes* Milne-Edwards to which, according to the extant literature, it should be included. An assessment of its taxonomic status was, therefore, felt necessary.

Blanford (1888) and Allen (1938) considered *A. assamensis* Anderson as a species distinct from *A. squamipes* Milne-Edwards. However, Ellerman & Morrison-Scott (1951) considered *Anourosorex* to be a monotypic genus with *A. squamipes* Milne-Edwards as the type-species having two subspecies, and without assigning any reason, synonymized *A. assamensis* Anderson with the nominate subspecies.

Examination of the material obtained from Assam and NEFA (32 examples of which measurements of 17 examples are given in Table 1) and critical evaluation of the characters of the population of south-eastern China, as given by Allen (1938), reveal the following facts :

The shrew from Assam, NEFA, is larger than that of south-eastern China. The former ranges from 85 to 114 mm. (mean 102·3 mm.) in head and body length, while the latter ranges from 80 to 85 mm. (mean 86·3 mm.). Allen states that the colour of the tail in the south-eastern Chinese population is dark brown, while in our Assam-NEFA material it is flesh coloured. Further, the claws are yellow (whether in dry or fresh specimens is not clear) in the former and generally white in the latter in fresh specimens. A small ochraceous tawny spot on the cheek is said to be usually present in the south-eastern Chinese shrew, but it is absent in our material. The skull is longer in Assam-NEFA shrew than that of the Chinese (greatest length 26·2 to 27·9 mm. mean 27·11 mm. *v.* 21·5 to 26·0 mm. mean 24·27 mm.).

Moreover, our examination of the adult female of the type-series of *A. assamensis*, a dry, mounted specimen, shows that the head and body length of 80 mm. is larger than the measurements given by Anderson ($2{\cdot}92''=c.$ 74 mm.). But its skull measurements come within the range of the material under study.

It would appear, therefore, that the populations of south-eastern China and Assam-NEFA are distinct from each other.

Thomas in his note to Wroughton (1916) is substantially correct in stating, '....while the Chin Hills shrew is the same as the Chinese one, the Assam one is different from both'.

Therefore, it seems necessary to resusciate Anderson's *assamensis* for the Assam-NEFA shrew, which should now be known as *Anourosorex squamipes assamensis* Anderson.

Anourosorex squamipes yamashinai Kuroda, restricted to northern Formosa, can easily be separated from all other subspecies by its smaller tail, ranging from 9 to 13 mm. (Kuroda 1935).

Petter (1963) has described another subspecies, *Anourosorex squamipes schmidi* from Bomdila (2,700 m.), Kameng Frontier Division, NEFA, on the basis of one adult and two young specimens. The distinguishing character of this subspecies is the greatest length of the skull which is 30·5 mm. Since we have not seen any material of this form, we are unable to comment on its status.

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ZOOLOGICAL SURVEY OF INDIA,
8, LINDSAY STREET,
CALCUTTA-16,
May 8, 1969.

A. K. MANDAL
P. K. DAS

TABLE

EXTERNAL AND CRANIAL MEASUREMENTS IN MILLIMETRES OF *Anourosorex squamipes assamensis* ANDERSON

Coll. No. Reg. No.	Locality & Altitude	Collector	Date	Sex	External Measurements			Cranial Measurements							Remarks
					Head and Body	Tail	Hind foot	Greatest length	Basal length	Palatal length	Breadth of brain case	Breadth across molars	Upper tooth row	Lower tooth row	
AM 25	Laban, Shillong, Khasi Hills, Assam (*c.* 1430 m.)	Dr. A. K. Mandal	4 Mar. 1964	..	98	15	18	27·5	26·8	10·6	14·8	8·1	11·2	10·5	
AM 26	-do-	-do-	19 Jun. 1964	♂	94	14	18	27·8	26·0	10·8	15·3	8·8	11·5	11·0	
AM 27	-do-	-do-	28 Jun. 1964	♀	85	12	18	26·9	25·2	11·4	14·2	8·3	11·9	10·9	
16556	Jowai, Jaintia Hills, Assam (*c.* 1370 m).	H. W. Wells	13 Jun. 1920	♂	107	12·5	15·5	26·2	23·9	10·9	14·5	8·1	12	10·9	Weight 31 gm.
16557	-do-	-do-	30 Jun. 1920	♂	92	13·5	14·5	25·8	24·0	11·3	13·8	7·7	11·3	10·6	Weight 22·7 gm.
16558	-do-	-do-	6 Jul. 1920	♀	95	13	15	26·6	24·5	11·5	13·9	7·8	12·1	11	Weight 28·3 gm.; mammae 3 pairs inguinal.

16559	Shangpung, Jaintia Hills, Assam (*c.* 1220 m.)	-do-	6 Aug. 1920	♂	105	16	15	26·3	24·1	11·3	..	7·9	11·9	11	
16550	-do-	-do-	7 Aug. 1920	♀	110	16	16	..	..	11·2	..	7·9	12	10·9	
16561	Dening, Mishmi Hills, NEFA (*c.* 685 m.)	-do-	25 Mar. 1921	♀	106	14	16	27·5	25·4	11·6	14·7	8·5	13	11·9	
16562	-do-	-do-	27 Mar. 1921	♀	114	14	16	27·5	25·9	11·7	14·6	8·2	12·5	11·4	
16563	-do-	-do-	27 Mar. 1921	♂	105	14	16	27·5	25·5	11·7	14·5	8·4	11·6	10·6	
16564	-do-	-do-	3 Apr. 1921	♂	112	14	16	26·5	24·7	11·5	14·5	7·9	12	11·4	
16565	-do-	-do-	3 May 1921	♂	108	14	16	26·9	25·1	11·3	14·5	7·8	12·5	11·4	
16566	Dreyi, Mishmi Hills, NEFA (*c.* 1565 m.)	-do-	28 May 1921	♀	107	19	17	27·4	25·4	12	14·8	9·3	12·6	11·4	Weight 35 gm., mammae pairs.
16567	-do-	-do-	29 May 1921	♂	92	17·5	16	27·8	25·4	12·4	14·1	8·8	12·4	11·9	
16568	-do-	-do-	10 Jun. 1921	♀	108	11	15	27·7	25·4	12·1	14·3	9·2	13·2	11·9	4 foetuses.
16569	-do-	-do-	10 Jun. 1921	♂	..	..	..	27·9	25·5	12	13·7	8·6	12·8	12	

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3. BLACK JACKALS (*CANIS AUREUS* LINN.) IN KERALA

Prater says in his BOOK OF INDIAN ANIMALS (1965 : 126) that black jackals 'are not uncommon in north India'. I wonder whether melanism in the jackal has been reported at all from south India. Perusal of the last 15 years' issues of this *Journal* helped to reveal nothing more than that the jackal has been badly neglected by our naturalists; I did not find a single note on this common animal. It may be of interest, therefore, to record some casual observations of a jackal pack found on the island of Dharmadam, Tellicherry taluk, which when first seen consisted of four adults: a black male, a grey female which was pregnant and two other grey animals one of which was a male. The pregnant female had cubs sometime late in March, 1969. Of the cubs one was an exact miniature of the black male.

Soon after my arrival at Dharmadam in the third week of October, 1968, the members of my family became deeply interested in a pair of jackals of which one was jet black with a thin white stripe down the centre of its chest. The other was a normal grey coloured female with a swollen belly and prominent teats. Occasionally these two were accompanied by two other normal jackals, with black only on the terminal two-thirds of their tails.

At first we thought that the black male, which looked larger than the three grey animals, was a village dog gone feral and living with the jackals. It not only looked larger and longer in the leg than the normal jackals, but had a tail which resembled an Alsatian's rather than the 'brush' of a jackal. But the animal reacted to the presence of dogs exactly as the normal jackals did; and dogs chased it just as they did other jackals. Moreover, in the frequent 'concerts' that we heard, there was no sound suggesting the barking or howling of a dog. For a time I thought that the black animal might be a hybrid ; but local people swear that the pi-dog never associates or has associated with jackals, and that the black animal is hundred per cent jackal.

On 3-i-1969 the black male was seen with the pregnant female and a grey adult. The female had a ' full ' belly and her teats swung about as she moved. On 31-i-69 at about 7 p.m. a jungle crow's excited cawing led to the discovery of a female jackal which had something black in its mouth. This thing was alive and whimpered exactly as a little pup would do. The jackal was running up and down in the dark shadows of bushes and I could note little more than that the thing in its jaws was no crow or crow's nestling.

Forty days later, on 13-iii-69, at 10 p.m. the rustling of dry leaves and a low whimpering drew our attention to a coal black cub and two brownish cubs in our backyard. The black cub was at the foot of a steep cutting while the other two were on the ledge above, trying hard to come down. All three uttered a low ' kyoo-kyoo . . kyoon kyoon-kyoom . . kyoom ' sound from time to time.

During the next eleven days we did not see the cubs. On the 24th of March they reappeared and were to be seen thereafter during the day, and for hours, playing or resting among dry bushes under a macaranga tree near a fence. Their camp was a compound full of pits and trenches.

On 7-iv-69 at 7.15 p.m. the cubs came down the cutting into our backyard and began playing in the brilliant moonlight like puppies. In the hope of attracting the jackal pack I had laid out a number of pieces of an over-ripe jack fruit in the backyard. The cubs repeatedly went up to these and nibbled. Hoping to draw them closer, I placed some rice and chappathis on a low parapet near them. On seeing me advancing they ran away though they had taken little notice of the six of us sitting 25 yards away under a 100-watt bulb. Fifteen minutes later the black cub came on to our verandah, sniffing and searching for food. It found and ate the pieces of chappathi I had strewn in the courtyard. Some time later all three cubs came right up to where my wife was sitting in a cane chair, but ran off when we moved. When we threw more chappathis to them the black cub and one of the grey cubs readily picked them up. We noted that they depended on their sense of smell to find the food, seeming to be unable to see things close to their faces.

I was able to study the cubs closely and found that the black one was an exact replica of the black male. It had the same white stripe down the middle of its chest. Of the other two cubs one was fawn-coloured and had strikingly white underparts. The last had the same grey and brown, or black and brown, mixture as a normal jackal. This cub had the terminal half of the tail black whereas the paler cub had very little black on its tail. The tails of all three were thin and tubular, without any suggestion of the adults ' brush '. Of the three the smartest and the prettiest was the fawn-coloured cub.

At 7.15 the next evening the black and the grey cubs came to our courtyard and ate chappathis avidly. The black one came up the steps and to the threshold itself. All night we heard their whimpering, and at 10 p.m., a regular ' concert ' by the adults in our backyard. The fawn coloured cub was never seen after the 7th.

At 7 a.m. on the 9th the black cub, the black adult and a grey adult were seen together. A little later the black adult and two grey adults were seen running away. Of the cubs there was no sign. At 8.10 a.m. the black cub, the black adult and two grey adults crossed the railway lines in front of our house, but less than half an hour later the black cub was back under the macaranga tree and the adults were nowhere to be seen.

Almost all day the black and the grey cubs were under the tree. At 6.30 p.m. they came down and each ate two cashew fruits which were on the ground. At this time a watchful grey adult was lying on a low bank, betrayed only by the occasional movements of its head and ears. An hour later the cubs came to our courtyard. I had scattered morsels of a sweetmeat made of rice dough, coconut gratings and jaggery. These the black cub ate with obvious relish ; but the grey hid in the shadows, picking up courage to advance into the well-lit courtyard only at the end, in time to get the last two pieces of the sweetmeat.

On the 10th the cubs were not seen in the day-time, but appeared at 7.30 p.m. ready to eat whatever we had to offer. Unfortunately their arrival coincided with that of a train and a crowd of noisy people in front of our house. These noises frightened the grey cub and it bolted, followed soon after by the black one. That was the last we saw of the cubs. They never came again to their usual haunts. But the adult black and the three grey adults continue to be seen here. On 20-iv-69 at 7 p.m. all four adults were in the area where the cubs used to spend the day between 24th March and 7th April.

General remarks : At first the cubs reacted to the beam of an electric torch quite unpredictably. Sometimes they smartly withdrew into the shadows of plantain trees and coconut trees, remaining there until the torch was switched off. Sometimes they behaved as if they were unaware of the bright beam. After they had got used to being examined by torch light, they ignored the light of a 500 watt bulb which I switched on again and again very close to them in my misguided attempts to photograph them.

The adults would normally stare for a few moments at the torch and scamper off. But on two occasions when a grey adult was with the cubs and the torch was directed their way, the adult uttered a single, short, gruff bark, a note resembling a dog's gruff bark on suddenly noting a stranger at the gate. After uttering this note the adult ran off leaving the cubs to shift for themselves. I suspect that the short bark was a note of warning to the cubs and not one of fear or anger.

Local jackals are very fond of ripe mango, jack and cashew fruits. They consume large numbers of the fruit of the fishtail palm also and are largely responsible for the dispersal of the seed. Jackals are said to be a great scourge to vegetable gardeners for they have a great weakness for cucumber and melon.

At 11.30 a.m. on 20-iii-69 a grey adult jackal carried off a month-old goat kid. It was the sudden hue and cry raised by koels, racket-tailed drongos and jungle crows that drew our attention to the jackal on this occasion. The koel I have found gets greatly upset and excited every time it notices a jackal passing. Common mynas utter their harsh alarm notes only at times, perhaps only when one of them is on the ground or is a juvenile. Crows normally ignore the jackal unless it happens to be carrying something in its mouth.

GOVT. BRENNEN COLLEGE,
DHARMADAM, TELLICHERRY,
April 23, 1969.

K. K. NEELAKANTAN

4. OCCURRENCE OF THE WOOLLY FLYING SQUIRREL, *EUPETAURUS CINEREUS* THOMAS (MAMMALIA : RODENTIA : SCIURIDAE) IN NORTH SIKKIM

Recently a specimen collected from North Sikkim (alt. 3000 metres) was sent by the Director (Locust Control) for Plant Protection, to this department for identification and subsequent donation to the National Zoological Collections. It has been identified as *Eupetaurus cinereus* Thomas, which according to authoritative literature (Blanford 1888 ; Ellerman & Morrison-Scott 1951 ; Ellerman 1963) is expected to occur only in Kashmir and Chitral (West Pakistan). The specimen in question is a flat skin without skull. In external characters it is very similar to the description given in standard literature and the ' Cotype ' present in the collection of the Zoological Survey of India. There are, however, some minor differences as mentioned below.

Dorsal hairs slaty on base and grey at tip, giving it a slate-grey appearance with slate dominating as against the grey colour of the ' Cotype '. The tail almost of the same colour as body but the tips of hairs are rusty-grey. Ventral colour light ashy with a median longitudinal line of coarse hairs, light grey in colour. Due to lack of sufficient material and the date of collection of the specimen under report, it is difficult to say whether this difference in coloration is a seasonal variation or subspecific. However, the occurrence of this species in Sikkim extends its distribution far eastwards, which is recorded.

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8 LINDSAY STREET,
CALCUTTA-16,
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V. C. AGRAWAL
S. CHAKRABARTY

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5. A NOTE ON *CICONIA NIGRA* (LINNAEUS) IN WEST PAKISTAN

The Black Stork (*C. nigra*) like the only other truly Palaearctic stork (*C. ciconia*) which visits the sub-continent in winter is also very rare and usually the only sight one is vouchsafed nowadays is a distant view of one or at the most 2 or 3 birds on some inaccessible sand-spit in the Indus or one of its main tributaries. Over the past six or seven years my own records include only two January sightings of solitary individuals at Panjnad Headworks on the Indus, plus a pair on the Chenab River on March the 10th above Marala Headworks. D. A. Holmes during three years intensive observations in Sind from 1962-65 saw only three solitary birds ; one near Hyderabad and two near Sukkur on the Indus (Pers. Comm. 1969). Even Dr. Ticehurst, fifty years ago saw only ' a few individuals about the Indus and Karachi harbour ' (Ticehurst 1923). It has therefore been an exciting discovery to find that Lal Soharan Reservoirs in the former Bahawalpur State attract considerable numbers of Black Storks and this locality is probably one of the main resting areas and concentration points for the species on its northward migration, as far as the whole sub-continent is concerned.

Lal Soharan on the border of the Cholistan Desert (approx. 29° 20'N. 72° 0'E.) has, by happy coincidence, been declared as a Wild Life Reserve by gazetted notification of the Government of Pakistan in November 1968. This has been a direct outcome of the two WWF missions led by Guy Mountfort to Pakistan in 1966 & 1967 to examine the status of the larger wild life species and to make recommendations for establishing National Parks and Wild Life Reserves (See WWF Projects No. 201 & 311—Second Report of the World Wildlife Fund 1965-67). The Reserve area comprising 85216 acres includes extensive undisturbed semi-desert biotope with irregular sand-hills covered mainly by *Calligonum polygonoides* (with its beautiful silvery twigs) and *Prosopis spicigera*. Interspersed between these high sand-hills are lower lying areas often covered with dispersed clumps of tall 'Sarkhan' grass (*Saccharum munja*) and denser breaks of the shorter *Saccharum spontaneum*. In its south-eastern corner the reserve includes an irrigated forest plantation and in the north-eastern corner there are extensive swampy areas with two open jheels created by summer storage of surplus irrigation water from the Indus, which has been regularly diverted to this area since the late 1930s. The two main bodies of water reach a depth of over 15 feet in summer and are dotted with tamarisk-covered islands. In winter the water is drawn off to supplement irrigation reserves but it is also replenished from time to time by the irrigation department and this fluctuating water level seems to create highly eutrophic conditions for birds as well as other forms of wild life. In late December it has been estimated that as many as 20,000 duck (including large numbers of mallard) rest in the area. Because of its remoteness from human settlements it naturally attracts shyer species such as of the Ciconiidae.

I have only made regular visits to these reservoirs since 1966 and have not observed any storks in that vicinity in the autumn passage of Palaearctic birds. The first observation of Black Storks at Lal Soharan was of a pair on January 2nd 1968. They were circling overhead and later settled in some dense *Saccharum spontaneum* grass in the desert about ¼ mile from the open water, which suggested that they might be able to find day time refuge in such areas and to be more than just casual visitors. However, a visit one year later on January 3rd 1969 revealed no Black Storks in the vicinity. On January 31st 1969, just at daybreak (approx. 7 a.m.) scattered groups of Black Storks were observed flighting into one of the main bodies of open water, each coming from the same direction in the desert where they had presumably been roosting during the night. They continued to arrive in small groups for about thirty minutes, settling in a flock on a sand bank in the middle of the water. Eighty-one individuals were counted but as it was impossible to count all the arriving groups or observe the whole area where they were feeding without disturbing the storks it is possible that there were even more than this number. There were three immature Black Storks clearly visible in this flock besides two Painted Storks. After questioning several herdsmen and fishermen in the vicinity it seemed evident that substantial numbers of Black Storks had been there during the previous week. Regrettably it was not possible to visit the area again in February 1968 or at the end of January 1969. It was therefore with some anxiety that I approached the main jheel on February 12th 1969 just at daybreak. Before reaching the vicinity, however, a flock of sixteen Black Storks in extended line flew overhead and within the next forty minutes

68 Black Storks and six Painted Storks flew over to land in a compact flock on the margin of the jheel. This time they came from two fairly widely separated directions in the desert, thirty-one from one roost and the remainder from the second area. No immature birds could be discerned in the flock and again by questioning local fishermen it appeared that the storks had been present ' for about two weeks '.

A few notes on their appearance would add to what I have been able to glean from the available literature (Ali & Ripley 1968 ; Baker 1922-30). The immature birds were identical in size to the adults but distinguished by dull black almost dark brown plumage in head, neck and wings, without any gloss. Their bills were yellowish horn coloured, legs greenish yellow and belly not pure white but greyish or sullied. In the adult the legs are a brighter coral red than those of its congener the White Stork whereas the bill is dark crimson with the tip horn coloured in a few individuals. The bright red naked skin around the eye extends to the upper cheeks and lores and the iris is dark brown. The plumage on the head and neck in certain lights showed an irridescent tinge almost as bright as the head of a drake mallard. When viewed in flight from underneath there is a distinctive white almost square patch extending beyond the axillaries and down the middle of each wing and adjacent to the body. This is not well illustrated in the drawing in the FIELD GUIDE TO THE BIRDS OF EUROPE (Peterson, Mountfort & Hollom 1966) whilst Smythies wrongly states that the whole of the wing appears black from below (Smythies 1953). Most of the birds observed fed in shallow water, probing with open bills and they were picking up fresh water snails which were extremely numerous in the drying out water weeds on the margin of the jheel. These snails comprised two species, the Banded Pond snail *Vivapara bengalensis,* and the rather soft shelled *Lymnaea acuminata.* It was not possible to ascertain if there was any discrimination in their feeding, between these two species. Due to the cold weather at this season, no frogs are evident at Lal Soharan in late January and early February. In 1968 in clear sunny weather, the storks ceased feeding at about 8.30 a.m. and flew back to the desert. Fishermen were becoming active at that time, however, and might have disturbed them. In 1969 in cloudy and dull weather the storks remained feeding until 9.40 a.m. when they began to leave in scattered parties. Again there was human activity in the vicinity which might have disturbed them. They did not appear to return to the jheel in the evening on either occasion unless they did so after darkness, so that in an interval of from 1½ to 2½ hours intensive feeding they apparently picked up all the food they needed, as the desert region where they were resting would seem to offer little in the way of suitable food beyond an occasional mole cricket (*Gryllotalpa* sp.) or Blue-Tailed Sand Lizard (*Acanthodactylus cantoris*) which appear to be common even in the dryiest areas.

Most individuals arrive in West Pakistan in the first half of October and depart again in early March. Whistler saw a flock of seven on the Sohan River (a very small stony stream) north of Rawalpindi on March 3rd which were obviously on northward passage (Whistler 1938). Ticehurst, however, noted an individual in Sind as late as April 5th (Ticehurst *op. cit.*).

It is hoped that as better protection measures are enforced at the new Reserve at Lal Soharan, that increasing use will be made of the area as a wintering ground by these strange and beautiful birds.

ROBERTS COTTON ASSOCIATES LTD., T. J. ROBERTS
KHANEWAL, MULTAN DT.,
WEST PAKISTAN,
February 20, 1969.

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6. ON THE OCCURRENCE OF *HALIAEETUS ALBICILLA* (LINNAEUS) IN WEST PAKISTAN

The Whitetailed Sea Eagle (*Haliaeetus albicilla*) in common with the larger raptors over most parts of the world, has suffered a decline in numbers during the 20th century, both as a result of human predation, and more recently no doubt as the result of the damaging effects on fertility resulting from widespread use of insecticides.

Though included in Volume **5** of the FAUNA OF BRITISH INDIA (Stuart Baker 1928) and listed therein as occurring as a winter visitor to the Punjab, North West Provinces and Sind, S. Dillon Ripley omits it from his SYNOPSIS (Ripley 1961). It is included, however, in Vol. **1** of the new HANDBOOK (Sâlim Ali & S. D. Ripley 1968) as a rare casual winter visitor to West Pakistan. A number of observations over the past three winters therefore seem worth recording. In the winter of 1966-67 at Ghauspur Jheel in north-western Sind (Sukkur District on the right bank of the Indus) Roberts saw a party comprising one old bird (with very pale almost white head and neck) and four immatures. There was a vast concourse of water fowl at this time and many other species of raptors. In January 1967, on a second visit, only one immature bird was observed. The following winter on December 8th one immature bird was again observed but in two visits in October 1968 and February 1969 none were seen, due possibly to failure of the monsoon and much less water in the region. On January 21st 1968 Savage saw two adult birds on a sand bank in the Indus River near Chashma (Mianwali District—north-western Punjab) and on February 2nd 1969 a solitary adult bird repeatedly quartering waterfowl over Nammal Lake in the Salt Range—about forty miles due north-west of the sighting at Chashma.

Two facts regarding these sightings are of interest. Firstly that adult birds were seen on three out of five occasions though the adults are considered to be sedentary and only the immature birds inclined to southern migratory movement in winter (Vaurie 1965). It seems, however, that Vaurie must be mistaken in considering adults to be sedentary except possibly in the southern parts of their range as it is inconceivable that northern birds can remain on their breeding grounds during winter. Dementiev does not suggest this and records from Iran and Pakistan certainly show that at least some adults move south. Secondly, in Pakistan at any rate, individual birds appear to visit approximately the same localities in successive winters.

The following records of previous sightings which have come to our notice would seem to be reliable and relevant. Ticehurst (1923) recorded a white-tailed adult on the Habb River in Las Bela near the Mekran coast on November 14th, 1919. In February 1940, Major-General Christison watched a female for several days, in of all places, the refuse dump outside Quetta city. He also cited another female seen on June 10th at Khushdil Khan Lake north of Quetta (Christison 1943). Paludan (1959) recorded an adult bird on March 4th, 1949 on the Hamun-e Sabari in the extreme south-western corner of Afghanistan close to the Iranian border. Moore & Boswell (1956) quoted nine records from Iraq during the months of September to December. In addition there are numerous records from northern Iran where the species is quite common along the Caspian littoral in winter and also breeds, though there is a marked diminution in numbers during spring. It is also a common winter visitor, both adults and juveniles, near the marsh land areas of Fars in southern Iran (L. Cornwallis in litt.), and in February 1969 Jacques Vieilliard (pers. comm.) sighted a pair in south-western Iran which he thought might have been breeding.

Vaurie (*op. cit.*) refers to small breeding populations of this eagle in Kirghizia, and in Russian Turkestan on the Amu Darya, but Dementiev (1951) suggests that the species is becoming extremely rare throughout most of the western part of its range ; e.g. in 1922 there were less than 20 pairs left in Sweden, and in the Ukraine in 1937 there were thought to be only two pairs left on the lower reaches of the Dnieper. It has already been exterminated as a breeding bird in many parts of its former range though it still occurs as a vagrant, e.g. in north-west Africa (Etchecopar & Hue 1967). Dementiev stated that it was still fairly abundant, however, in the tundra and forest tundra of the north along the large river valleys such as the Ob, Yenesei, and Kolyma. It seems probable therefore that the sightings in Pakistan were of Russian breeding birds.

The Ghauspur eagles afforded plenty of opportunity for leisurely observations, and in his field notes, Roberts records that immature birds have a very distinctive and easily recognised tail pattern. Besides the flight silhouette with comparatively short and wedge-shaped tail, when viewed closely, each rectrice is dull white with a definite narrow dark brown border around the outer edge of both webs. The tail feathers are somewhat pointed also and not spatulate as in that of most *Aquila* species. The outer tail feathers bear some brown mottling near the main rib but the general pattern of white with a narrow dark brown border is both striking and clearly discernible even from underneath when the bird is soaring overhead. The cere is clear yellow in adult birds, but these immature eagles observed had bluish horn ceres and compared with the other eagle species their loose plumage and rather untidy appearance was noticeable, as was the pale base to many of the breas and mantle feathers.

One of the immature eagles observed at Ghauspur also captured a teal in the following manner. An individual duck had swum some distance from the nearby flock, whereupon the young eagle immediately launched itself from the dead tree stump where it had been sitting and with comparatively ponderous flapping flight it stooped over the teal which dived under the water. Though the eagle took considerable time and space tc turn around and make a further stoop it repeated this process four times during each of which the teal succeeded in escaping by diving. On the fifth occasion the duck must have been exhausted as it did not dive in time and the eagle plunged on top of it entering the water (which seemed to be fairly shallow) up to its breast. It thereupon carried off the teal in one foot but was immediately harassed by an Imperial Eagle (*Aquila heliaca*)—and though noticeably smaller the latter succeeded in robbing it of its prey. The HANDBOOK (Ali & Ripley *op. cit.*) states that the voice has not been recorded in India, but on another occasion a pair were watched circling overhead and calling frequently to one another with a low yelping sort of noise, reminiscent of a puppy dog and quite unlike the drawn out musical call of its congener, Pallas's Fishing Eagle. They soared effortlessly and to an immense height in exactly the same manner as vultures.

WILDFOWL SURVEY,
C/O. 11-F GULBERG,
POST BAG 704,
LAHORE,
WEST PAKISTAN,
July 3, 1969.

T. J. ROBERTS
C. D. W. SAVAGE

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7. BLACKWINGED KITE, *ELANUS CAERULEUS VOCIFERUS* (LATHAM) TAKING IN FLIGHT A WOUNDED GREEN PIGEON, *TRERON PHOENICOPTERA* (LATHAM)

On 6 September 1969, while collecting birds at Shindewadi (near Poona, 2½ kilometres south-east of Katraj Tunnel) I came across a pair of Blackwinged Kites *Elanus caeruleus*. They were very wary. I stalked them for well over an hour without being able to get within range for shooting with a twelve bore shotgun. The birds did not venture very far but kept on changing perches in an approximately 1 sq. kilometre area. While chasing them I noticed some green pigeons, *Treron phoenicoptera* on a tall *Ficus* tree. Giving up the kites I went for the pigeons. At a pre-arranged signal my helper flushed them out of the tree by throwing a stone. As the group of fifteen or so flew above me, I managed a long shot injuring one. As the injured bird was sailing through the air losing height one of the Blackwinged Kites, who immediately after the shot had appeared on the scene, swooped on it and carried it away. By the time I got over my surprise it was well out of range.

The Blackwinged Kite normally takes larger insects, young or sick birds, small reptiles and rodents. Only once has it been recorded to take a wounded quail. All these are much smaller and comparatively lighter in weight than itself. To take a full grown pigeon, almost its equivalent in weight, speaks volumes for the courage and strength of this little Kite.

WESTERN REGIONAL STATION,
ZOOLOGICAL SURVEY OF INDIA,
1182/2, FERGUSSON COLLEGE ROAD,
POONA-5,
September 27, 1969.

B. S. LAMBA

8. OCCURRENCE OF THE TEREK SANDPIPER, *TRINGA TEREK* (LATHAM) IN KERALA

Though the distribution of the Terek Sandpiper is given in the HANDBOOK OF THE BIRDS OF INDIA AND PAKISTAN : **2** (1969) as ' Winter visitor to the entire seaboard from W. Pakistan . . . and western India from Kutch and Saurashtra south to the tip of the Peninsula . . .', the bird is not included by Sálim Ali in the BIRDS OF KERALA (1969). This is curious because in the ' Vernay Survey of the Eastern Ghats ' (*JBNHS* **39** : 255) Whistler has stated that he was told by Phythian-Adams that he shot 2 from a flock at Cannanore on 12th December, 1931. Whistler refers also to Jerdon's record of having seen this bird once ' at the edge of the Trichur Lake '.

On 24th November, 1968, on the sands at the mouth of the Dharmadam River, I saw two small sandpipers which had strikingly upturned bills. I watched them from a distance of 25 yards, through 10×45 binoculars with the sun behind me. Details noted down on the spot are given below :

> Size about the same as that of the Little Ringed Plover ; legs and feet pale orange or yellowish-orange ; long up-curved, slender bill horny-black except for the basal one-third which was red ; a faint supercilium.

One of the birds had a broken right leg, and it hopped about instead of running like its companion. There were a few Sandplovers about, but these two remained together all the time.

The up-curved bill and the orange legs make the identity of the bird quite certain.

GOVT. BRENNEN COLLEGE, K. K. NEELAKANTAN
DHARMADAM,
KERALA,
May 25, 1969.

9. THE SMOKY LEAF WARBLER, *PHYLLOSCOPUS FULIGIVENTER* (HODGSON) IN NEPAL

On 18 June 1964, while surveying the alpine avifauna of the Gosainkund region of central Nepal, I observed at close range a leaf warbler which I had no difficulty in identifying as *Phylloscopus fuligiventer* from its peculiar habit of foraging on big boulders. The only other leaf warbler to clamber about rocks and boulders is *Ph. griseolus*, a greyer bird with yellowish buff underparts which, occurs on arid slopes west of Lahul and Spiti. *Ph. fuligiventer* is a dull brownish olive bird with greenish yellow underparts and supercilium. Its song, for which I can find no published description, is a monotonous repetition of a single note that may be rendered as *tsli-tsli-tsli-tsli-tsli* or sometimes an almost disyllabic *tsuli* . . . The area was a rock-strewn alpine meadow at an altitude of 4300 metres, well above tree-line and also above scrub growth. See also the *Ibis* **107** (1965) : 400-401.

Another sight record is reported by G. Diesselhorst (Khumbu Himal, Vol. **2** : 273, Innsbruck-München, 1968) from Gokyo north of Namche Bazar at nearly 5000 m. on July 27. The altitude, habitat and behaviour undoubtedly indicate *Ph. fuliginventer*, a species not heretofore reported west of Sikkim in the breeding season.

U.S. NATIONAL MUSEUM,
DIVISION OF BIRDS,
WASHINGTON, D.C. 20560,
September 20, 1969.

M. DESFAYES

10. NESTS OF THE BAYA, *PLOCEUS PHILIPPINUS* (LINNAEUS) ON TELEGRAPH WIRES

Colonies of the nest of the Baya (*Ploceus philippinus*) on telegraph wires are not unknown in India (Kirkpatrick 1952 ; F. N. Betts 1952). However, the following observations may perhaps be of interest.

While searching for breeding colonies of the Finn's Baya in Dhora Dam area, near Rudrapur, Kumaon terai, Naini Tal Dist., on 10 September, 1962, I saw a very large concentration of Baya nests on the telegraph wires running through sugarcane fields. In all there were 117 nests distributed in seven groups of 7, 14, 70, 5, 4, 5 and 12 nests. The breeding season was nearly over, but a few nests contained young ones as evidenced by the feeding trips of the parents. The nests were without long attachments, and the entrance tubes of the nests were also greatly reduced.

These structural adaptations to the new situation of the nesting site probably serve to reduce swinging movements. It was interesting to observe that although suitable trees were available bordering the sugarcane fields yet the birds selected the telegraph wires for nesting.

NEW RANGARI BLOCK,
OLD G.B. ROAD,
BANDRA, BOMBAY,
May 20, 1969.

V. C. AMBEDKAR

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11. BLACKCROWNED FINCH-LARK, *EREMOPTERIX NIGRICEPS AFFINIS* (BLYTH) IN GUJARAT

There appear to be no records of the Blackcrowned Finch-Lark in Gujarat till the bird was recorded at Kuar Bet in the extreme north of Kutch in March 1960 during the course of the BNHS/WHO Bird Migration Study Camp. Subsequently Dharmakumarsinhji recorded the bird at Bhavnagar on 12th March 1962. On the 28-ii-69 Dharmakumarsinhji and myself saw a flock of these larks at Rajawadla Tank near Jasdan. I saw a flock on 14-iii-69 and single males on 6-iv-69 and 19-iv-69 at various widely separated places 12 to 20 miles from Jasdan. Dharmakumarsinhji saw the bird at Khodiyar Dam near Bhavnagar on 26-iii-69. The bird seems to be wandering down in winter from Sind and Rajasthan where it is resident and may possibly even breed in Northern Gujarat and Kutch.

JASDAN,
GUJARAT,
May 8, 1969.

Yuvraj SHIVRAJKUMAR

12. RECOVERY OF RINGED BIRDS

Ring No. and Sex	Date and place of ringing	Date and place of Recovery	Remarks
	Pintail Duck (*Anas acuta*)		
F–1231 ♂	10-10-1966. Bharatpur, Rajasthan (*c.* 27° 13′N., 77° 32′ E.)	+ 8-3-1969. Kazakh SSR, Chimkent Reg., near Temirlanovka (*c.* 42° 38′N., 69° 15′E.)	Reported by Bird Ringing Centre, Moscow, USSR
F–1265 ♂?	11-10-1966 -do-	+ 0-9-1968. Novosibirsk Reg., near Barakinsk (*c.* 55° 24′N., 78° 20′E.)	-do-
F–1388 ♀	18-10-1966. -do-	+ 2-11-1968. Uzbek SSR, Syr-Dariya Reg., Tuzkan Lake (*c.* 40° 36′N., 67° 30′E.)	-do-
F–1687 ♂	30-9-1967. -do-	15-9-1968. Lake Chany, Novosibirsk, Russia (*c.* 55°N., 77°E.)	Reported by Prof. A. Maximov, Novosibirsk
F–1743 ♂	13-10-1967. -do-	+ 19-5-1969. Tomsk Reg., Near Parabel (*c.* 58° 41′N., 81° 29′E.)	Reported by Bird Ringing Centre, Moscow, USSR

Ring No. and Sex		Date and place of ringing	Date and place of Recovery	Remarks
		Pintail Duck (*Anas acuta*)—*contd.*		
F–1782	♂	21-10-1967. Bharatpur, Rajasthan (*c.* 27° 13′ N., 77° 32′E.)	21-3-1969. Ranagarh Village of Surendranagar Dist., Gujarat State, near Nal Sarovar (*c.* 22° 43′N., 71° 59′E.)	Reported by H. L. Lalka, R.F.O.
F–1804	o ?	23-10-1967. -do-	15-9-1968. Ramagiri Tank of Pamidi Village, Anantapur Dist., A.P. (*c.* 14° 57′N., 77° 36′E.)	Reported by Shri Ramalingam
F–1855	♂	25-10-1967. -do-	+ 22-9-1968. Irkutsk Reg., near Kirensk (*c.*57° 45′N., 108° 10′E.)	Reported by Bird Ringing Centre, Moscow, USSR
F–2220	♂	10-11-1967. -do-	× 25-5-1969. Tyumen Reg., Krasnosel Kupskii Dt., near Kikiakki (*c.* 63° 49′N., 82° 42′E.)	-do-
F–2238	♀	11-11-1967. -do-	+ 20-9-1968. Altai Reg., Blagove Shchensk Dist., near Shimolino (*c.* 53° 00′N., 79° 59′E.)	-do-
F–2546	♂	23-11-1967. -do-	+ 12-5-1968. Tomsk Reg., near Kolpashevo, (*c.* 58° 21′N., 82° 56′E.)	-do-
F–2602	♀	25-11-1967. -do-	+ 25-2-1969. Tadjik SSR, near Pendzhikent (*c.* 39° 30′N., 67° 36′E.)	-do-
F–3107	♀	11-12-1967. -do-	+ 14-10-1968. Dzhambul Reg., Balkash Lake (*c.* 47° 00′N., 75° 00′E.)	-do-
F–3666	♀	29-12-1967. -do-	+ Autumn 1968. Alma-Ata Reg., near Bakanas (*c.* 44° 53′N., 76° 14′E.).	-do-
F–4256	♂	24-1-1968. -do-	+ 18-5-1969. Tomsk Reg., near Parabel, (*c.* 58° 41′N., 81° 29′E.)	-do-
F–4989	♂	18-2-1968. -do-	+ 3-10-1968. Kokchetav Reg., near Kokchetav. (*c.* 53° 20′N., 69° 25′E.)	-do-
F–4994	♀	18-2-1968. -do-	+ 8-9-1968. Alma-Ata Region, near Kuigain (*c.* 45° 20′N., 74° 20′E.)	-do-
F–5021	♂	18-2-1968. -do-	+ 9-5-1968. Tyumen Reg., near Megion (*c.* 60° 00′N., 76° 04′E.)	-do-
F–5392	♂	27-2-1968. -do-	+ 2-9-1968. Pavlodar Reg., near Tavolzhan (*c.* 52° 43′N., 77° 24′E.)	-do-
F–5482	♂	27-2-1968. -do-	+ 13-5-1968. Tomsk Reg., near Asino (*c.* 57° 03′N., 86°09′E.)	-do-

Ring No. and Sex		Date and place of Ringing	Date and place of Recovery	Remarks
		Pintail Duck (*Anas acuta*)—*contd.*		
F–5665	♀	3-3-1968. Bharatpur, Rajasthan (*c.* 27° 13′N., 77° 32′E.)	+ 10-5-1968. Krasnoyarsk Region, Turukhansk Dist., near Verkhne-Imbatskoe (*c.*63° 10′N., 88° 00′E.)	Reported by Bird-Ringing Centre, Moscow, USSR
		Common Teal (*Anas crecca*)		
C–1672	o ?	13-10-1966. Bharatpur, Rajasthan (*c.*27° 13′N., 77° 32′E.)	26-2-1969. Sukheke, Mandi Dist., Gujranwala, West Pakistan (*c.*32° 11′N., 74° 1′E.)	Reported by Mr. Kauid Mosood
C–1758	♀	5-12-1964. Manjhaul, Monghyr Dist., Bihar (*c.* 25° 23′N., 86° 30′E.)	+ 10-5-1969. Buryatian ASSR, near Orongoi, (*c.* 51° 30′N., 107° 06′E.)	Reported by Bird Ringing Centre, Moscow, USSR
C–2742	♂	20-10-1966. Bharatpur, Rajasthan, (*c.*27° 13′N., 77° 32′E.)	+ 15-5-1969. Tomsk Reg., near Ust'-Tym. Kargasok Dist. (*c.*59° 27′N., 80° 00′E.)	-do-
C–3487	♂	27-10-1967. -do-	+ 24-5-1969. Tyumen Reg., Nizhne-Vartovsk Dist., near Larjak (*c.*61° 05′N., 80° 17′E.)	-do-
C–3538	♂	29-10-1967. -do-	6-4-1969. 5 miles off Muridke Sheikhupura, West Pakistan (*c.*31° 77′N., 73° 97′E.)	Reported by Sh. Ahmed Saeed
C–3612	♀	5-11-1967. -do-	+ 18-5-1969. Tomsk Reg., Kolpashevo Dt., near Staro-Korotkino (*c.*58° 02′N., 82° 59′E.)	Reported by Bird Ringing Centre, Moscow, USSR
C–3633	♀	5-11-1967. -do-	+ 27-9-1968. Karaganda Reg., Balkhash Lake (*c.*45° 58′N., 74° 30′E.)	-do-
C–3695	♀	6-11-1967. -do-	+ 17-5-1969. Tomsk Reg., near Parabel, (*c.*58° 41′N., 81° 29′E.)	-do-
C–3750	♂	6-11-1967. -do-	+ 0-10-1968. Kemerov Reg., near Taiga (*c.*56° 04′N., 85° 37′E.)	-do-
C–3848	♂	7-11-1967. -do-	+ 25-9-1968. Novosibirsk Reg., near Chistoozernoe (*c.*54° 45′N., 76° 36′E.)	-do-
C–4081	♂	11-11-1967. -do-	+ 15-9-1968. Kazakh SSR, near Zelinograd (*c.*53° 10′N., 71° 28′E.)	-do-
C–4124	♂	12-11-1967. -do-	9-4-1969. Jullunder Dt., Punjab (*c.*31° 20′N., 75° 35′ E)	Reported by Mohmida Singh
C–4421	♂	30-11-1967. -do-	+ 25-8-1968. Tuva, near Kyzyl. (*c.*51° 41′N., 94° 31′E.)	Reported by Bird Ringing centre Moscow, USSR

Ring No. and Sex		Date and place of Ringing	Date and place of Recovery	Remarks
		Common Teal (*Anas crecca*)—*contd.*		
C-4472	♂	1-12-1967. Bharatpur, Rajasthan (*c.* 27° 13′N., 77° 32′E.)	+ 8-9-1968. Alma-Ata Reg., Balkash Dist., near Kuigan (*c.*45° 20′N., 74° 10′E.)	Reported by Bird Ringing Centre, Moscow, USSR
C-4622	♂	6-12-1967. -do-	+ 22-9-1968. Alma-Ata Reg., near Talgar (*c.*43° 17′N., 77° 14′E.)	-do-
C-4663	♂	7-10-1967. -do-	26-2-1969. Sukheke, Mandi Dist., Gujranwala, West Pakistan (*c.* 32° 11′N., 74° 1′E.)	Reported by Mr. Kauid Mosood
C-4737	♂	3-12-1967. -do-	+ 15-3-1969. Kirghiz S.S.R., Osh Reg., near Kara Su (*c.* 43°N., 73°E.)	Reported by Bird Ringing Centre, Moscow, USSR
C-5361	♂	21-1-1969. -do-	25-5-1969. Krasnoyarsk Reg., Eniseiskii Dist., near Lugovatka (*c.*59° 05′N., 89° 04′E.)	-do-
C-5363	♂	21-1-1969. -do-	+ 1-3-1969. Syr-Dariya Reg., near Dzhizak (*c.* 40° 07′N., 67° 49′E.)	-do-
C-5364	♂	-do- -do-	1-4-1969. Swat Valley, Pakistan, Waliahad (*c.* 34° 72′N., 73° 3′E.)	Reported by Saidu Sharif
C-5544	♀	3-3-1968. -do-	+ 12-9-1968. Kazakh S.S.R., near Charyn (*c.* 43° 45′N., 79° 23′E.)	Reported by Bird Ringing Centre Moscow, USSR
		Spotbill Duck (*Anas poecilorhyncha*)		
G-039	Ad.	7-3-1969. Bharatpur, Rajasthan (*c.* 27° 13′ N., 77° 32′E.)	+ 14-7-1969. Etah Dist., 52 miles north of Agra, U.P. (*c.* 27° 46′N., 78° 56′E.)	Reported by Ram Gopal Singh
		Gadwall (*Anas strepera*)		
F-4397	♂	31-1-1968. Bharatpur, Rajasthan (*c.* 27° 13′N., 77° 32′E.)	6-4-1969. Kashmir, Srinagar (*c.* 33° 70′N., 74° 1′E.)	Reported by Mr. Mohd Rafiq
F-4436	♀	31-1-1968. -do-	+ 31-3-1968. Kazakh S.S.R., Zelinograd Dis., near Alekseevka (*c.*52° 00′N., 71° 01′E.)	Reported by Bird Ringing Centre, Moscow, USSR
F-5494	♀	28-2-1968. -do-	+ 31-8-1968. Kazakh SSR, Dzhambul Reg., near Furmanovka (*c.* 44° 17′N., 72° 55′E.)	-do-
F-5599	♀	1-3-1968. -do-	+ 0-7-1968. Altai Reg., near Blagoveshchenka (*c.* 52° 50′N., 79° 42′E.)	-do-

Ring No. and Sex		Date and place of Ringing	Date and place of Recovery	Remarks
		Wigeon (*Anas penelope*)		
F–1617	♂	15-1-1967. Nalbandh, Chilka Lake, Orissa (*c.* 19° 56′N., 85° 6′E.)	+ 25-5-1969. Yakutian ASSR, Near Vilyuisk (*c.* 63° 50′N., 121° 38′E.)	Reported by Bird Ringing Centre, Moscow, USSR
F–3181	♀	14-12-1967. Bharatpur, Rajasthan (*c.* 27° 13′N., 77° 32′E.)	+ Autumn 1968. Irkutsk Region (*c.* 53° 38′N., 104° 6′E.)	-do-
F–4199	♀	23-1-1968. -do-	+ 25-5-1969. Yakutian ASSR, Near Lensk (*c.* 60° 42′N., 114° 55′E.)	-do-
F–6702	♂	28-2-1969. -do-	+ 16-5-1969. Tomsk Region, near Kolpashevo (*c.* 58° 21′N., 82° 56′E.)	-do-
		Garganey (*Anas querquedula*)		
C–3201	o ?	7-10-1967. Bharatpur, Rajasthan (*c.* 27° 13′N., 77° 32′E.)	6-11-1969. Attur, Salem Dist., Madras (*c.* 11° 23′N., 77° 46′E.)	Reported by Dr. S. Amritsami
C–5631	♂	9-3-1968. -do-	9-3-1969. Mirgund, Srinagar, Kashmir (*c.* 33° 70′N., 74° 1′E.)	Reported by Mr. Mohd Rafiq.
		Shoveller (*Anas clypeata*)		
F–1593	♂	11-1-1967. Noapara, Chilka Lake, Orissa (*c.* 19° 56′ N., 85° 6′E.)	+ 31-5-1969. Yakutian ASSR, Vilyuik Dist., near Khampa (*c.* 62° 57′N., 115° 13′E.)	Reported by Bird Ringing Centre, Moscow, USSR
F–2578	♂	24-11-1967. Bharatpur, Rajasthan, (*c.* 27° 13′ N., 77° 32′ E.)	+ 24-9-1968. Altai Region, near Kalmanka (*c.* 55° 55′N., 83° 31′E.)	-do-
F–3236	♂	20-12-1967. -do-	+ 0-9-1968. Tomsk Reg., near Kolpashevo (*c.* 58° 21′N., 82° 56′E.)	-do-
F–4434	♂	31-1-1968. -do-	28-2-1969. Dist., Muzaffargarh, Multan Divn. (*c.* 30° 4′N., 71° 12′E.)	Reported by Shri Malik Mahmud Ahmed, Multan Cantonment
F–4911	♂	14-2-1968. -do-	+ 1-9-1968. Buryatian ASSR. The delta of the Selenga (*c.* 52° 20′N., 106° 30′E.)	Reported by Bird Ringing Centre, Moscow, USSR
F–5345	♂	26-2-1968. -do-	+ 24-3-1969. Kazakh SSR, Chimkent Reg., near Chulakkurgan (*c.* 43° 46′N., 69° 09′E.)	-do-
F–5390	♀	27-2-1968. -do-	+ 5-9-1968. Kzyl-orda Reg., near Novokazalinsk (*c.* 45° 52′N., 62° 11′E.)	-do-
F–5503	♀ ?	28-2-1968. -do-	+ 19-5-1969. Tomsk Reg., near Kargasok (*c.* 59° 04′N., 80° 51′E.)	-do-

Ring No. and Sex	Date and place of Ringing	Date and place of Recovery	Remarks
	Shoveller (*Anas clypeata*)—*contd.*		
F–5553 ♂	29-2-1968. Bharatpur, Rajasthan, (*c.* 27° 13′N., 77° 32′E.)	+ 12-9-1968. Severo-Kazakh Reg., near Yuvlenka (*c.* 54° 22′N., 68° 28′E.)	Reported by Bird Ringing Centre, Moscow, USSR
F–6742 ♂	9-3-1969. -do-	+ 19-5-1969. Tomsk Reg., Kargasok Dt., near Ust'-Chizhanka (*c.* 59° 00′N., 79° 30′E.)	-do-
	Common Pochard (*Aythya ferina*)		
F–4204 o ?	23-1-1968. Bharatpur, Rajasthan (*c.* 27° 13′N., 77° 32′E.)	+ 5-9-1968. Kazakh SSR, Balkhash Lake (*c.* 46° 00′N., 74° 14′E.)	Reported by Bird Ringing Centre, Moscow, USSR
F–4444 ♀	1-2-1968. -do-	19-3-1969. Khusnak, Sargodha Dist., West Pakistan (*c.* 32° 4′N., 72° 43′E.)	Reported by Mr. Shah
F–4551 ♂ Ad.	5-2-1968. -do-	+ 15-9-1968. Kazakh SSR, Kokchetav Reg., near Kokchetav (*c.* 53° 19′N., 69° 22′E.)	Reported by Bird Ringing Centre, Moscow, USSR
F–4953 ♀	16-2-1968. -do-	+ 30-8-1968. Kurgan Reg., near Lebyazhie (*c.* 55° 16′N., 66° 31′E.)	-do-
	White-eyed Pochard (*Aythya nyroca*)		
F–3369 ♂	22-12-1967. Bharatpur, Rajasthan (*c.*27° 13′N., 77° 32′E.)	+ 0-3-1969. Kazakh SSR, Alma-Ata Reg., near Chilik (*c.*43°N., 77° 1′E.)	Reported by Bird Ringing Centre, Moscow, USSR
	Tufted Duck (*Aythya fuligula*)		
F–4154 ♂	22-1-1968 Bharatpur, Rajasthan (*c.* 27° 13′N., 77° 32′E.)	19-3-1969. Mahbubnagar, A.P. (*c.*16° 81′N., 78° 1′E)	Reported by Mr. Md. Ibrahim
F–4699 o ?	9-2-1968. -do-	+ 1968. Omsk Region	Reported by Bird Ringing Centre, Moscow, USSR
	Coot (*Fulica atra*)		
F–2164 o?	7-11-1967. Bharatpur, Rajasthan, (*c.* 27° 13′N., 77° 32′E.)	+ 1-7-1968. Kazakh SSR, Dzhambul Reg., near Dzhambul (*c.* 42° 54′N., 71° 24′E.)	Reported by Bird Ringing Centre, Moscow, USSR
F–3192 o ?	15-12-1967. -do-	+ 0-10-1968. Chimkent Reg., near Chardara (*c.* 41° 20′N., 67° 54′E.)	-do-
F–3195 o ?	15-12-1967. -do-	+1-9-1968. Severo kazakh Reg.	-do-

Ring No. and Sex	Date and place of Ringing	Date and place of Recovery	Remarks
	Coot (*Fulica atra*)—*contd.*		
F–3434 o?	27-12-1967. Bharatpur, Rajasthan, (*c.* 27° 13′N., 77° 32′E.)	+ 12-9-1968. Kazakh SSR, Balkash Lake (*c.* 46° N., 74° 14′E.)	Reported by Bird Ringing Centre, Moscow, USSR
F–5865 Ad.	21-1-1969. -do-	+ 29-3-1969. Tadjik SSR, near Shaartuz (*c.* 37° 12′N., 68° 08′E.)	-do-
	Comb Duck (*Sarkidiornis melanotos*)		
66–352 ♀	27-2-1968. Bharatpur, Rajasthan, (*c.* 27° 13′N., 77° 32′E.)	8-8-1969. Tonk, Rajasthan. (*c.* 26° 10′N., 75° 48′E.)	Reported by Khan Bhadar Mahmood Khan
	Little Stint (*Calidris minutus*)		
A–93726 o?	10-10-1969. Point Calimere, Thanjavur Dt., Tamil Nadu (10° 18′N., 79° 51′E.)	20-10-1969. North Vanjur, near Karaikal, Pondicherry	Reported by Mr. K. Kanagasabai
	Curlew-Sandpiper (*Calidris testaceus*)		
AB–12967 o?	27-9-1967. Bharatpur, Rajasthan (*c.* 27° 13′N., 77° 32′E.)	13-6-1969. Tanjore Dt., Mayuram Taluk, Madras (*c.* 10° 30′N., 78° 50′ E.)	Reported by A. M. Abdul Kader
	Ruff (*Philomachus pugnax*)		
AB–14060 ♂	11-10-1967. Bharatpur, Rajasthan, (*c.* 27° 13′N., 77° 32′E.)	15-12-1968. Near Amkhera, Jabalpur Dist. (*c.* 23° 6′N., 79° 4′E.)	Reported by C. H. Samida
AB–15447 ♀	3-11-1967. -do-	+ 21-5-1969. Magadan Reg., near Susman, (*c.* 62° 50′N., 148° 11′E.)	Reported by Bird Ringing Centre, Moscow, USSR
B–2132 ♂	13-10-1966. -do-	+ 20-5-1969. Yakutian ASSR, near Suntar (*c.* 62° 10′N., 116° 50′E.)	-do-
B–4097 ♂	30-9-1967. -do-	+ 22-5-1969. Yakutian ASSR, near Olekminsk (*c.* 60° 22′N., 120° 26′E.)	-do-
B–4588 ♂	25-10-1967. -do-	31-2-1968. Mandi, Bahauddin, West Pakistan, (*c.* 31° 64′N., 76° 91′E.)	Reported by Mr. G. Rasul
B–4600 ♂	25-10-1967. -do-	+ 12-3-1969. Turkmen SSR, near Tedzhen (*c.* 37° 23′N., 60° 30′E.)	Reported by Bird Ringing Centre, Moscow, USSR
B–4730 ♂	3-11-1967. -do-	+ 25-5-1969. Krasnoyarsk Reg., near Severo-Eniseiskii (*c.* 60° 23′N., 93° 00′E.)	-do-

Ring No. and Sex	Date and place of Ringing	Date and place of Recovery	Remarks
	House Sparrow (*Passer domesticus*)		
A–82898 ♂	22-1-1969. Bharatpur, Rajasthan, (*c.* 27° 13′N., 77° 32′E.)	× 19-5-1969. Tadjik SSR, Moscow Reg., near Kulab. (*c.* 37° 55′N., 69° 48′E.)	Reported by Bird Ringing Centre, Moscow, USSR
	Common Rosefinch (*Carpodacus erythrinus*)		
AB–21078 ♀	18-3-1969. Bharatpur, Rajasthan, (*c.* 27° 13′N., 77° 32′E.)	+ 16-6-1969. Uliyanovsk Reg., near Inza (*c.*53° 50′N., 46° 21′E.)	Reported by Bird Ringing Centre, Moscow, USSR

BOMBAY NATURAL HISTORY SOCIETY, BOMBAY
December 1, 1970.

EDITORS

13. OCCURRENCE OF THE ROCK LIZARD (*PSAMMOPHILUS* SP.) IN TIRUKKALIKKUNRAM HILL, CHINGLEPUT DT., TAMIL NADU

The two species of the genus *Psammophilus* occur, according to Smith (1935), FAUNA OF BRITISH INDIA, Reptiles **2** : 208-210, at ' considerable altitudes ' on hills in their distributional range in Peninsular India. I have also seen the species of the genus usually above 2000 ft., and was therefore surprised to see specimens of *Psammophilus* on the 500-feet high Tirukkalikunram Hill situated 50 miles south-west of Madras. I was also not aware of the occurrence of *Psammophilus* so close to Madras though *Psammophilus dorsalis* has been recorded from South Arcot.

BOMBAY NATURAL HISTORY SOCIETY,
BOMBAY,
June 15, 1969.

J. C. DANIEL

14. DEFANGED COBRAS, HOW THEY SURVIVE

In July 1968, in Bangalore I met and spent some time with a ' snake-charmer ' named Sayed Imam. He and his sons travel to Thailand, Viet Nam, Cambodia and Malaysia every year making their living mostly around the U.S. Military bases there. As the vast majority of snake-charmers do, he defangs the cobras he uses in his act. In his younger days he had been bitten a few times and had scars and a couple of mis-shapen fingers as evidence. He said that he would show me how he defangs cobras, but no fresh snake was brought in while I was there. He did give me a description of the procedure which is as follows : The snake is pinned and grasped behind the head by one of the men, who holds the snake's mouth open with a stick. The head is held upside down so the fangs are easily accessible. Using a small wire and an ordinary or long-nosed type of electrician's pliers another man lifts back the fang sheath (thin membrane covering the fangs) and grips the fang just at its junction with maxilla. The fang is ripped out and then the reserve fangs are probed and pulled out. The procedure is repeated then on the other side. The fangs may or may not grow back ; it depends on how much damage was done to the underlying bone and tissue when they were ripped out. At any rate it can take some months or even years for a defanged snake to grow them back, and the snake-charmers make a check once in a while.

Though the fangs are gone, the venom glands are still active and productive, the venom still flows from the duct when the snake bites. The other small teeth in a cobra's mouth cause tiny skin punctures so that venom ejected out onto the skin might be absorbed. Though hardly as dangerous as a regular venom injection through the fangs, a vaccination such as this of a cobra's toxic venom could prove fatal. Sometimes the cobras pterygoid and mandibular teeth may also be ripped out (which I have seen them do with *Natrix* and other harmless snakes for tourists to handle). Another procedure Imam described is to take a thin razor blade and slit up through the venom gland which is then drained and the snake's cheek area normally full from the swelling of the venom becomes hollowed. This procedure probably kills many snakes within a short time, but as people who keep snakes find out, there are always some especially hardy individuals which live on and on. Cobras are particularly hardy snakes.

If asked what is fed to their snakes, snake charmers invariably tell you eggs, or milk and eggs. Many of them keep a snake for only a few months, until it becomes too weak from starvation to be an effective display. Others, like my acquaintance in Bangalore, use a funnel connected to a rubber tube to force-feed the snakes with an egg-milk mixture. The tube is inserted about six inches down the cobra's throat, the mixture poured in and the snake held head up for some minutes to prevent regurgitation. Though an inadequate diet, cobras are kept alive for two or more years on it.

I acquired a defanged cobra mistakenly in a lot designated for venom extraction. I regularly feed snake specimens white lab mice and wild mice. I killed and offered one to the defanged snake. He showed interest and came to the mouse and smelled it over. I prodded the mouse with a stick which excited the snake into biting it and hanging on for some minutes, just as if it were waiting for its venom to take effect. Then the cobra swallowed the mouse, though with some difficulty, as some of its small teeth were gone. Its clumsiness in feeding with the absence of fangs and teeth was noticeable. At the time of this writing, eight months later, this snake is a healthy specimen, feeding well, still on dead mice with less difficulty. The venom gland areas are still hollow and there is no sign of the fangs growing back.

C/o K. Chattopadhyaya,
Chateau Marine No. 6,
Marine Drive,
Bombay-1,
April 30, 1969.

ROMULUS WHITAKER

15. COBRA, *NAJA NAJA* (LINN.), AND INDIAN MONITOR LIZARD, *VARANUS MONITOR* (LINN.) IN THE SAME BURROW

On November 22, 1968, I was called to Nagala Village, Gaimukh-bunder, Ghodbunder Road, Thana, to catch a cobra in a hole under a tree. In trying to drag the snake out, it went deeper and soon its head appeared out of a hole on the other side of the tree. We first tried to pull it out by the tail, but it would not yield, we then tried to induce it to continue through, also in vain. The snake seemed to be stuck as it acted unnaturally, keeping its mouth open and not moving forward or back. I thought that perhaps it had swallowed a large rat and thus was caught under the roots. Carefully two workers dug away at the hole and tree roots until nearly half the snake's length was revealed. Securing a grip on the cobra's neck I then dug around its body to free it. In a few minutes we had the snake out and ready to bag. Just then a monitor (*Varanus monitor*), a large one, came rushing out of the same hole, under our legs. With some difficulty it was caught and the 5 feet cobra and $3\frac{1}{2}$ feet lizard put into separate bags. When a *Varanus* is disturbed it tightly inflates its body with air, which prevents its removal from rock crevices and holes. The cobra, upon entering the monitor's dwelling caused the lizard to swell up at the disturbance, blocking the snake's progress in either direction.

C/o Chattopadhyaya,
Chateau Marine No. 6,
Marine Drive,
Bombay,
December 30, 1968.

ROMULUS WHITAKER

16. PRESENCE OF VOCAL SACS IN A FEMALE SKIPPER FROG *RANA CYANOPHLYCTIS* SCHNEIDER

Vocal sacs and nuptial pads are the best known secondary sexual characters of the male among frogs. In *R. cyanophlyctis* the vocal sacs balloon out through slits on the chin. While examining the Society's collection of over 200 specimens of this species, a female obtained by P. B. Shekar and P. W. Soman in July 1962 at Koyna Nagar, Satara Dt., Maharashtra, was seen to have fully developed vocal sacs on both sides of the chin. The ovaries were ripe though slightly reduced on the left side. The lungs were unusually small. The specimen measures 60 mm. in snout to vent length.

I am not aware of this abnormality being noticed in this species before.

BOMBAY NATURAL HISTORY SOCIETY,
HORNBILL HOUSE,
SHAHID BHAGAT SINGH ROAD,
BOMBAY-1 BR,
October 27, 1969.

SARAMMA ISAAC
Research Assistant

17. *THALAMITA POISSONII* (AUDOUIN & SAVIGNY) DE MAN, (CRUSTACEA: BRACHYURA), A NEW RECORD TO INDIAN COASTS

(*With two text-figures*)

In April, 1968, I collected 22 specimens of the crab, *Thalamita poissonii* (Audouin & Savigny) De Man (Fig. 1), from the sublittoral fringe of the Adatra Reef on south-western coast of Port Okha (22° 27′N, 69° 46′E) in the Gulf of Kutch. Of the specimens collected, 11 were males.

The largest male measured:

Length of Carapace ..	23 mm.
Breadth of Carapace ..	38 mm.
Width of the inter-orbital space ..	20 mm.
Greatest diameter of the orbit ..	4 mm.

Alcock (1899) reports that the specimens of this species in the Indian Museum, collected from the Persian Gulf, had the propodite

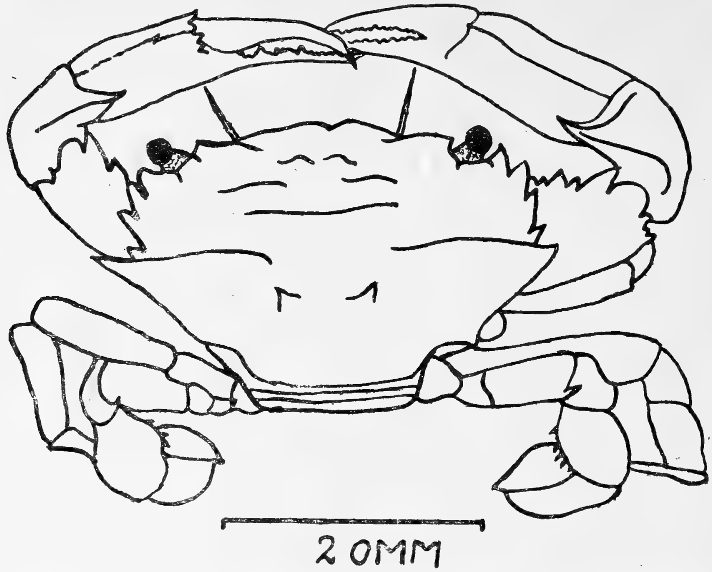

Fig. 1. *Thalamita poissonii* (Audouin & Savigny) De Man, Male.

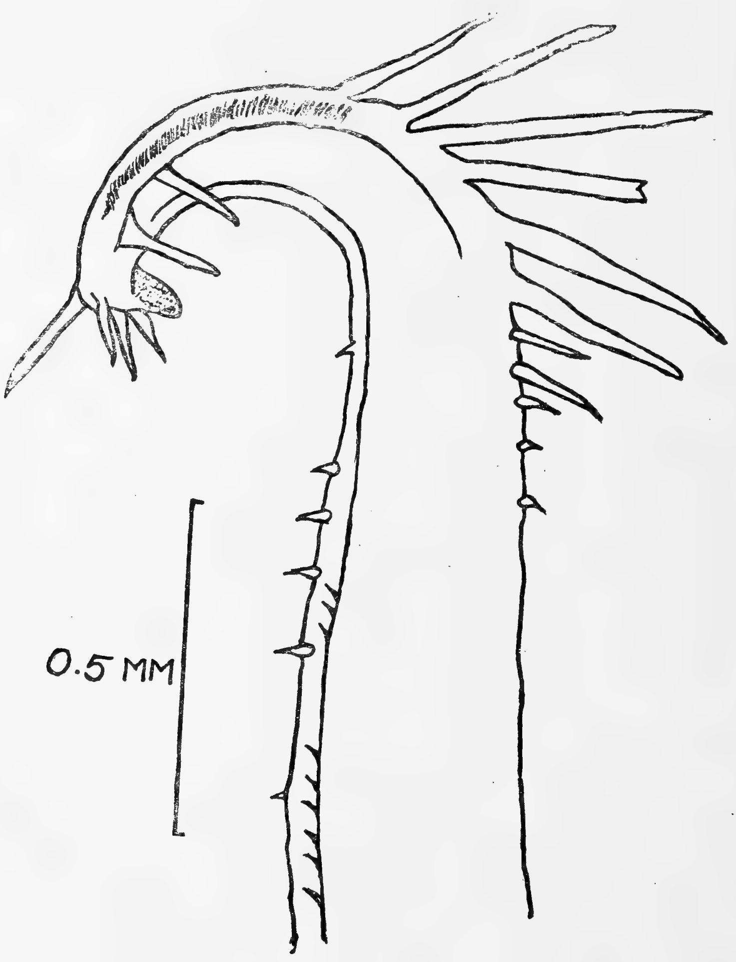

Fig. 2. Tip of 1st Male Pleopode

of the last pair of legs armed with 2 or 3 small spinules. The present specimens have 3 to 7 spinules.

The tip of the first male pleopode, is strongly recurved. The armature on the proximal part of the appendage consists of 11 to 15 long and short spines towards the outer side, and 15 spinules, on the inner side. The terminal armature is of 4 spines towards the outer side and 2 to 3 spines on the sides of the appendage.

The distribution of *Thalamita poissonii* (Audouin & Savigny) De Man is reported to be Madagascar, Red Sea and Suez, Laccadive Islands, Ceylon and Marshal Island. The present report on the occurrence of this species in the Gulf of Kutch extends its distribution to the Indian coast also.

ACKNOWLEDGEMENTS

I am thankful to Dr. W. Stephenson, Professor, University of Queensland, for examining the specimens and confirming the identification, and to Mr. K. V. Nawathe, Director of Fisheries, Gujarat, for kindly permitting the publication of this note.

MARINE BIOLOGICAL RESEARCH STATION,
GOVERNMENT OF GUJARAT, MOHAN CHANDY
PORT OKHA,
March 28, 1969.

REFERENCE

ALCOCK, A. (1899): Materials for a Carcinological Fauna of India. No. 4. The Brachyura Cyclometopa. Part II. A revision of the Cyclometopa, with an account of the families, Portunidae, Cancridae and Corystidae. *J. Asiatic Soc. Bengal* **68**: 1-104.

18. SOME OBSERVATIONS ON THE MILLIPEDE, *PHYLLOGONOSTREPTUS NIGROLABIATUS* (NEWPORT 1844) (DIPLOPODA, MYRIAPODA), FROM POONA

The millipede *P. nigrolabiatus* was reared in the laboratory for certain histochemical investigations. Some very interesting observations were recorded on the captive specimens in the laboratory and on specimens in their natural habitat. These observations add information to the known data and are presented here.

MATERIAL

The millipedes are very common in the vicinity of Parvati hills, Poona, in an uncultivated area between the right bank of the Mutha canal and Swargate-Khadakwasla road. After the first heavy monsoon showers, millipedes can be seen crawling aimlessly, not only over the ground but over trunks and branches of the trees and shrubs. They are found in large numbers when the atmosphere is cloudy and humid and become rare in the last week of August.

The millipedes were reared in glass jars of 9×5×11 inches and 8×5×8 inches dimensions, containing dry or wet (moisture contents —18·66%, 30·00%, and 14·44%), compact or loose soil beds. They were also reared in unlined petri dishes of 8·00 cm. and 15·00 cm. diameter.

A few animals died during the first three months of captivity, but from November onwards the number of deaths increased without any obvious reason, and by April and May none was left in captivity.

Burrows:

The burrows of *P. nigrolabiatus* are long and tubular and are made in wet or water saturated, loose or compact soil beds. When the beds were compact, primary burrows were generally made at the corners of the jar. This was done probably because the soil was not as compact there as it was in other places. Primary burrows were mainly vertical with a few exceptions. Their length depended on depth of the soil bed. Their diameter was a little more than that of the dorsum of the millipedes. The vertical burrows of those in captivity for sometime were found to be inter-connected by horizontal or diagonal branches. In a few cases tubular burrows lead to 'chamber-like' expansions. One of them was $3 \times 4\frac{1}{2} \times 4$ cm. in size.

In loose soil beds millipedes moved the soil with the help of their labrum and gnathochelarium. They used the epicranial plate as fulcrum and pushed the shovelled soil backwards with gnathochelarium and anterior pair of appendages. After pushing the soil they moved forward and started work. Part of the excavated soil was carried out and deposited on the bed.

Cloudsley-Thompson (1958)[1] states that millipedes do not burrow but, probably push their way through soil. Millipedes do push their way through soil, but only in unfavourable circumstances and through water saturated soil. The burrowing is stopped either through fatigue or when they reach the wall of the jars. In unbranched burrows they enter headfirst and reverse out. When two animals crawled into the same

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[1] Cloudsley-Thompson, J. L. (1958) : Spiders, Scorpions, Centipedes and Mite, Pergamon Press, London,

burrow from opposite directions, generally one crawled over the other and passed on. In some cases one coiled and this action pushed the soil aside and gave room to the other.

Food:

Millipedes are predominantly vegetarian, feeding on soft, fleshy, fresh or decayed algae, moss, tender leaves and fruits. On the collection ground they were found feeding on inflorescence of ficus, rotting fruits, etc., and were twice seen feeding on dead and decaying slug and snail. Once a millipede was seen feeding on a dead millipede.

In captivity, during the rainy seasons, they were fed mostly on moss and spirogyra. During winter and summer, they were fed on *Valisneria, Elodea,* coriander leaves, pontederia roots, onion leaves, fruits like apples, guava, sapota, banana-pulp and skin, coconut, cucumbers and red pumpkin. They showed a preference for moss and spirogyra.

Gut contents of freshly collected millipedes examined showed many algal filaments, various forms of diatoms, a desmid, a large number of spores and also substantial amount of tender and succulent leaves. The contents except spores, were partially or completely digested.

Breeding:

Pairing started from the last week of July and lasted till October Copulation took place at different hours but more frequently in the morning. The male and female interlock jaws and the male coils round its mate. The act is lengthy and the duration variable. In captivity, egg-laying did not occur.

Parasites:

A few ecto- and endo-parasites were found on and inside the millipedes. Among endo-parasites a nematode *Rondonema* sp. (Artigas) (Dr. Inglis—Personal communication) and a ciliate (Order Holotricha) were most common. A few bacteria were also seen. The nematodes and ciliates dwelt in the hind-gut while bacteria were observed both in the mid-gut and hind-gut and in the body cavity, especially in the vicinity of the stink gland. Infection rate of nematodes was very high. Almost each and every millipede was infected.

Mites belonging to subfamily Phytoseiinae of the family Phytosiidae were collected from the millipedes. They were found on anterior parts of the body. Infection was generally observed when the animals were fed on moss. This suggests the mite may not be a parasite in the true sense and this is possibly an example of phoresy.

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DEPARTMENT OF ZOOLOGY,
N. WADIA COLLEGE,
POONA-1,
September 2, 1969.

P. V. JOSHI

19. BIONOMICS OF *AMPHIBOLUS VENATOR* (KLUG) A REDUVID PREDATOR ON INSECT PESTS OF STORED PRODUCTS

INTRODUCTION

Amphibolus venator (Klug), a reduvid bug, is found in grain godowns and is a predator on almost all insect pests of grains and serves as a natural control over the pest population, feeding as it does on all stages of the insect pests. Its natural habitat appears to be dark corners, crevices and grain bags in godowns. Its number in the godowns increases along with the general increase in the population of insect pests.

Miller (1956) states, that this bug is universally distributed in warehouses through the agency of man, and is now cosmopolitan in distribution.

In order to study its relationship with the insect population of storehouses the present investigation was carried out and observations were made on the bionomics of the bug.

PRECOPULATION AND COPULATION

The freshly emerged adult female does not respond to the male for mating. On an average, four to five days are required after emergence for the female to respond to the male for mating. Before copulation the male moves behind the female for sometime and later succeeds in mounting. The male clasps and grips the female with fore-legs, the female remaining quiet during the mating. Sometimes she moves around with the male on her back. The copulation takes about twenty to twenty-five (20 to 25) minutes.

Oviposition and Fecundity

The first oviposition takes place 1 to 5 days after copulation (average of 2·8 days). The period from the day of emergence of the adult to first oviposition is five to ten days, (average of 6·9 days). The eggs are laid in rows of 2 or 3. In the warehouse the female selects the spot for laying eggs in corners of jute bags preferably away from light. In the laboratory culture batches of eggs were glued to the surface of the container by their broader ends. The maximum number of eggs laid by a female was 237 and the minimum 80, the average being 128·8.

Eggs

Eggs when laid are creamy-white in colour and ovoid in shape. At the end of the incubation period of about 9 to 10 days the eggs assume reddish colour because of the developing embryo inside. At the same time the eggs shrivel towards the conclusion of the incubation. The first instar nymph emerges through the lid which is on the narrower end of the egg. First the head emerges followed by the rest of the body. The average measurements of 10 eggs are, length 1·82 mm., and breadth 0·806 mm.

Description of the various instars and their duration

The insect undergoes five instar stages before emerging as imago. All the nymphs hatching out on the same day did not grow at the same rate although the food, temperature and relative humidity were the same throughout. The duration of the nymphal period varied from 51 days to 134 days.

First Instar:

The freshly hatched nymphs are small and delicate measuring about 2·476 mm. in length and reddish in colour. Gradually the body becomes dark brown except the abdomen which remains orange red. The dorso-lateral portion of the abdominal tergae has yellowish spots on either side. In the advanced stage the nymph measures about 3·08 mm., in length; with greatest width 1·108 mm. across the fifth abdominal segment. Body ovoid; head straight, twice as long as broad, measuring about 0·873 mm. in length. Compound eyes deep red, bulging out of the sides of the head. Maximum width of head is at the region of the eyes and measures about 0·458 mm. Antennae five-jointed reddish in colour and are about 1·67 mm. in length. The first segment is the shortest (0·12 mm., second 0·44 mm., third 0·31 mm., fourth 0·23 mm., fifth 0·57 mm.) and the last the longest.

A prominent white line from the frons of the head, along the thorax up to the first segment of the abdomen. This line is the ecdysial cleavage line through which the next instar emerges. The ecdysial line continues throughout the nymphal stage and becomes more prominent in the later stages. The rostrum is apparently three-segmented, measuring about 0·87 mm. in length and reaches up to prothorax; the distal segment bears very small sensory bristles. The head is connected to the thorax by a narrow constriction of the head. The thorax is distinct with three segments, prothorax, mesothorax and metathorax. The ecdysial mid-dorsal white line creates an impression of being three sclerites on either side. The wing rudiments are absent. The thoracic spiracles are situated ventro-laterally on meso and metathorax. Legs stout, with six joints, tarsi two-segmented. Prothoracic leg is directed forward and is of raptorial type. The femora of prothoracic and mesothoracic legs are incrassated bearing tubercle-like processes; perhaps useful in holding the prey in between femur and tibia.

Abdomen about 1·580 mm. in length ovoid, with ten visible segments. The 11th is ordinarily telescoped in the 10th and both segments are small, telescoped inside the 9th and are retractile. These evert if the abdomen is pressed. There are three dark spots on the abdominal tergae which are situated mid-dorsally. Eight pairs of abdominal spiracles. The first pair situated on the antero-lateral side of the first abdominal tergum and the rest situated ventro-laterally from 2nd to 8th sternum.

The duration of the life of the 1st instar nymph is 8 to 17 days (average 11·7 days).

Second Instar:

Second instar nymph is 3·985 mm. in length and 0·997 mm. across the thorax and 1·296 mm. across the abdomen. Head cylindrical, straight and measures 1·093 mm. in length, width across eyes 0·534 mm. Antennae five-jointed, 2·001 mm, in length, Rostrum about 1·18 mm. in length. Prothoracic and mesothoracic sclerites are distinctly separate, the posterior surface of the notum convex. Prothorax is the widest segment of the thorax.

Legs are similar to those of the first instar nymph. The abdomen becomes swollen and ovoid and increases in length up to 2·043 mm. The ten segments of the abdomen are visible, the two last segments, 10th and 11th, are retractile as in the first instar. The sides of the abdomen are beset with yellow patches.

The duration of the life of the second instar nymph is 8 to 14 days (average 9·50 days).

Third Instar:

The third instar nymph measures about 5·165 mm. in length, colour same as of the second instar. Head 1·336 mm. in length and width across eyes 0·641 mm. Rostrum is 1·399 mm. in length. Thorax characterised by the marked development of pronotum which becomes convex laterally. Although the wing-pads are not distinct the postero-lateral sides of the mesonotum and metanotum exhibit lateral blunt outgrowths, which are equal in length. The maximum width of the thorax is 1·299 mm. There is no differentiation of mesonotum into scutum and mesoscutellum. The portion of the mesonotum is projected over the metanotum. The abdomen is elongated and is 2·6695 mm. in length. Maximum breadth across the abdomen 1·740 mm. All the abdominal segments are distinct. The last segment bears the anus.

The legs are similar to those of the second instar except for the increased size and length. The position of the abdominal spiracular openings is the same as in the first instar nymph. The duration of life of the third instar is 9 to 26 days (average 13·6 days).

Fourth Instar Nymph:

The fourth instar nymph resembles the preceding instar. It is about 6·302 mm. in length. The head capsule measures 1·336 mm. in length. The eyes project out from the antero-lateral aspects, and the width across the eyes is 0·734 mm. Antenna five-segmented and about 3·032 mm. in length. Thorax characterised by the marked development of the pronotum and mesonotum. Mesonotum widens and becomes convex. The development of the mesoscutellum is also observed and the midregion of the mesoscutellum produces a triangular projection posteriorly. The length of the mesonotum increases considerably. The dark wing-pads of the mesonotum and metanotum increase and extend up to the second abdominal segment; are distinctly clear in this instar. The metanotum is comparatively poorly developed. The legs are similar to those of the third instar nymph but the serrations on the femurs of the first and second legs are blunt and not so prominent. The abdomen is elongate, ovoid and is 3·074 mm. long and the maximum width is 1·905 mm. The openings of the tracheae are as before. Duration of the life in fourth instar nymph is 10 to 28 days (average 16·0 days).

Fifth Instar:

The colour of the fifth instar nymph is dark brown initially but later it gradually lightens. It measures about 8·069 mm. in length. Head cylindrical and straight measuring about 1·962 mm. in length. Maximum width across the eyes is 0·868 mm. Antennae five-jointed and 3·668 mm. in length. Intercalary segments of the antennae are not yet developed. The rostrum becomes stouter and bent and is about 2·05 mm. in length. There are marked changes in the thorax in the fifth instar nymph. The thorax is about 2·20 mm. long, the width is 1·975 mm. The pronotum becomes broader and shows the same sculpturing as in the imaginal pronotum. Mesonotum develops immensely as compared to the metanotum. The mesonotum can be distinguished into scutum and scutellum, although the transverse suture is not developed. Wing-pads grow enormously, extending up to the third tergum and are black in colour. The mesothoracic wing-pads totally cover the metathoracic wing-pads. Abdomen is elongated and swollen. It measures about 4·23 mm. in length, with a maximum width of 2·517 mm. The first abdominal spiracle which is dorsal in position is prominent. The sides of the tergae exhibit yellow patches. Duration of life in the fifth instar nymph is 16 to 49 days (average 28·50 days).

Imago:

The freshly emerged imago is reddish in colour. The wings are transparent and colourless. After some time the colour of the body of the imago changes to black.

The male and female can be distinguished by the size and the length of the body. The male is smaller than the female and measures about 9·06 mm. in length, the width of the abdomen is 3·00 mm. The female measures 9·713 mm. in length. The abdomen is 3·253 mm. in width. The major changes from the fifth instar nymph to adult are mainly the appearance of the full wings, the formation of thoracic tergal plates and the external genital plates. Ocelli appear on the head. The intercalary segments in the antennae are developed and pretarsus becomes three-segmented.

Longevity and Sex Ratio:

The length of life of the adult mated female is from 65 to 193 days, average being 116·5 days. The number of males and females in population is not equal. Average percentage of the two sexes was —males 44·55% and females 55·45%.

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INSTITUTE OF SCIENCE,
BOMBAY,
June 28, 1968.

V. V. SURLIKAR
V. B. TEMBE

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20. ON THE TIME OF EMERGENCE OF *CROCE FILIPENNIS* WESTW. (NEUROPTERA: NEMOPTERIDAE)

Croce filipennis Westw. is a beautiful insect of small size with an average forewing span of 2·5 cm. and an average body-length of one centimetre. It has clear, transparent and membranous forewings with the characteristic Neuropteroid venation. The hindwings are strikingly modified into long and narrow filamentous structures whose average length is 3·2 cm. The insect is active during twilight and is also attracted to light. Though a poor flier, the insect flies with graceful up and down movements with hindwings vibrating and trailing behind at an acute angle to the vertical. This beautiful insect is not commonly met with even by entomologists because of the restricted period of its emergence.

The authors could collect in Calicut, Kerala, considerable numbers of this insect only during the first two weeks of March, 1968, before and after which time, the insects could not be found. The same observation was made during the year 1967 also. From this, it is inferred that, *Croce filipennis* Westw. has only one generation in a year (Imms 1911); that its emergence is apparently restricted to a short period around the first two weeks of March in Calicut; and that the insect has a relatively short span of life, definitely not exceeding two weeks.

DEPARTMENT OF ZOOLOGY,
MALABAR CHRISTIAN COLLEGE,
CALICUT-1,
KERALA,
March 25, 1968.

A. B. SOANS
J. S. SOANS

REFERENCE

IMMS, A. D. (1911): On the life history of *Croce filipennis* Westw. *Trans. Linn. Soc. Lond.* (2) **11** : 151-160.

21. EGG 'DIAPAUSE' OF *HIEROGLYPHUS NIGROREPLETUS* BOLIVAR (ORTHOPTERA: ACRIDIDAE)

Hieroglyphus nigrorepletus Bolivar, commonly called 'phadka', is a serious pest of *Zea mays*, maize, *Sorghum vulgare* jawar, *Pennisetum typhoidium*, bajra in India. Investigations on different aspects of this grasshopper have been published by Bhatia 1949; Pradhan & Peswani 1961; Pruthi 1949; Rao & Cherian 1940; and Roonwal 1945. According to Roonwal (1945) the incubation period in nature is roughly of ten months. This leads to the presumption that the hatching period is lengthened on account of egg diapause. Pradhan & Peswani (1961) attempted in the field as well as under controlled conditions to break this egg diapause of *H. nigrorepletus*, without success. In the course of our study on the digestive physiology of *H. nigrorepletus* we were successful in shortening the incubation period significantly in order to get regular supply of various stages of this grasshopper throughout the year.

Two sets of egg pods of *H. nigrorepletus* were selected for the experiments. The first set contained freshly laid egg pods collected from the field in September. The second set consisted of the egg pods laid by the adults in oviposition tubes (4″×1″) under controlled conditions in the same month. Each egg pod generally has 45 to 55 eggs in it. On examination it was observed that in each egg pod the eggs were covered with a distinct brownish layer made up of the secretion of the accessory glands mixed with soil particles. These sets of egg pods were separately kept buried in loose soil (mixture of sand and earth) in the incubation tubes which were kept at 38°C ± 1°C and relative humidity ranging between 60% to 70%. Further, the soil of the incubation tubes was periodically watered so as to keep it damp and to prevent dessication.

The observations are based on the experiments conducted during three consecutive years. It showed that 88% of the eggs laid under controlled conditions hatched out at an average of 30 days. Likewise, the eggs collected from the fields and kept under identical controlled conditions also took the same period, but in this case the percentage of hatching was approximately eighty per cent.

It is, therefore, concluded that the egg diapause (as it is called by Pradhan & Peswani 1961) in *H. nigrorepletus* can definitely be broken under effective temperature and humidity (i.e. 38°C and R.H. 60% to 70%) and a requisite moisture of the soil containing the egg pods. This conclusion is at variance with that arrived at by Pradhan & Peswani (op. cit.) who maintained that the long incubation period of these eggs was due to egg diapause which remained irresponsive to the artificial adjustments in physical factors. They further elaborated it by holding the seasonal factors related to the onset of monsoon as only responsible for hatching, as is evident from their statement, 'if the egg pods failed to come in contact with moisture between June and August the eggs would not hatch later that year but would remain in that condition till the next season'.

We conclude that regular wetting of the soil is responsible for making the hard outer covering of the pods pervious and facilitates moisture absorption by the eggs. This process becomes effective in stimulating the development and growth of the embryo at a quicker pace under high temperature and humidity. Keeping in view the present observations on the role of physical factors on the development of eggs of *H. nigrorepletus* it is suggested that the term 'quiescence' would be more appropriate than 'diapause' for the long incubation period of *H. nigrorepletus* eggs which are laid at the end of monsoon season.

We wish to express our gratitude to Professor S. M. Alam for his valuable suggestions and constructive criticism.

ENTOMOLOGY SECTION,
DEPARTMENT OF ZOOLOGY,
ALIGARH MUSLIM UNIVERSITY,
ALIGARH, U.P.,
April 30, 1968.

S. SHAKEEL A. RIZVI
MUMTAZ AHMAD KHAN

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22. NEW RECORD OF A PHYTOSEIID MITE, *AMBLYSEIUS FINLANDICUS* OUDM, OCCURRING IN SUGARCANE WITH NOTES ON ITS LIFE HISTORY AND BIONOMICS

(*With a photograph*)

In India four different species of phytophagous mites have been recorded on sugarcane. Out of these, two are spider mites (Tetranychidae) which commonly damage the crop, and the other two species are the rust mite and the sheath gall mite belonging to the family Eryophydae. Field observations during 1965 in the Sugarcane Research Station, Bhubaneswar, Orissa, revealed that another species i.e., *Amblyseius finlandicus* Oudm (Phytoseiidae) was associated with sugarcane along with the spider mite *Paratetranychus indicus* Hirst, and caused some injury to the plants.

The occurrence of *Amblyseius finlandicus* on sugarcane has not been reported earlier. Accounts of its biology and taxonomic description are found in the reports of Collyer (1956) and Chant (1957, 1958, 1959). *A. finlandicus* is active in the field throughout the year, and feeds on leaf sap and preys upon the spider mite *P. indicus* as well. The present study was initiated to obtain detailed knowledge of its life history and bionomics on different kinds of food materials, and its possible significance in relation to its role as a predator of pests or pest of sugarcane.

METHODS

The phytoseiid mites were collected from the field by clipping off portions of sugarcane leaf on which they were found in large numbers, and kept in specimen tubes. These were brought to the laboratory and removed to specially designed cages with a fine camel hair brush. The mites were easily visible under a magnifying glass, and no difficulty was experienced in transferring them. Rearing was done in petri dishes of 7·5 cm. inner diameter in which liquid paraffin was poured up to 1/3 cm. depth. After solidification they were filled in with water to about ½ cm. below the rim. Cut pieces (5 cm. long) of fresh sugarcane leaves were kept inside the petri dishes toward the middle below which a thin layer of cotton padding was provided. More water was added to the petri dishes so as to just touch the leaf margin and serve as a barrier for the mites. Different kinds of food such as, honey, the mite (*P. indicus*) and a combination of both were provided on the cut pieces of sugarcane leaves where the phytoseiid was released. This method was found to be convenient for examining the mites under microscope from time to time without disturbing them much.

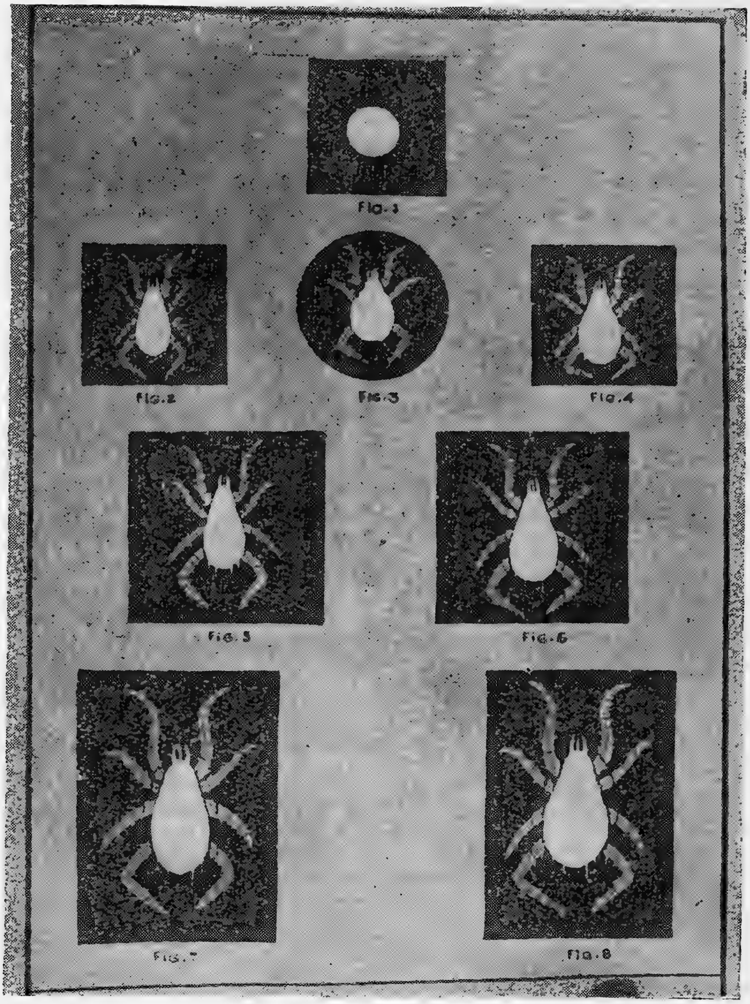
DESCRIPTION OF LIFE STAGES

Egg

Freshly laid eggs appeared transparent white and soon changed to light straw colour. They were elliptical in shape, and the average length and breadth measured 0·164 mm. and 0·123 mm. respectively. The egg chorion was quite hard which helped in their easy transfer without causing any damage. The data presented in Table 1 show that the incubation period varied from 36 to 58 hours. The different types of food supplied had very little effect on the speed of embryonic development. In the wet months of July to September the incubation period was slightly prolonged.

Larva

As soon as the larva emerged out of the egg it moved about actively on the leaf surface. Its body was more or less round and pearl white in colour. Average length and breadth measured 0·205 and 0·144 mm. respectively. The first of the three pairs of legs was the longest, and the other two were almost equal in size. Larval development was completed within 38 to 44 hours on the different diets supplied. At this stage the mite did not accept the prey mite as food, and preferred to feed on the leaf sap rather than the honey droplets provided in the cages. It was interesting to note that the



Different stages of *Amblyseius finlandicus* Oudm.

(Magnified 60 to 70 times the natural size)

FIGS. 1. Egg; 2. Male protonymph; 3. Larva; 4. Female protonymph 5. Male deutonymph; 6. Female deutonymph; 7. Adult male; 8. Adult female;

larval development was faster with sugarcane leaf alone as food. When honey was supplied with the leaf, the larvae required 5 to 6 hours more to complete this stage of development. The prey mites given in the cage were left unharmed by the phytoseiid larva.

TABLE 1

EFFECT OF DIFFERENT FOOD MATERIALS ON THE DURATION OF IMMATURE STAGES, ADULT LONGEVITY AND RATE OF REPRODUCTION OF *A. finlandicus* (AVERAGE DURATIONS)

Food	Incubation period (Hours)	Larva (Hours)	Protonymph (Days	Hours)	Deutonymph (Days	Hours)	Adult longevity (Days)	Number of eggs laid per female
Sugarcane leaf ..	37 to 57	39	6	20	8	12	4 to 6½	3
			6	23	8	14		
Sugarcane leaf + Honey ..	36 to 58	44	6	16	8	06	16 to 19	5
			7	05	8	16		
Sugarcane leaf + *P. indicus* ..	36 to 48	38	6	20	8	13	12 to 17	9
			6	23	8	16		
Sugarcane leaf + *P. indicus* + Honey ..	43 to 58	43	6	20	8	16	19 to 20	18
			7	05	8	20		

Nymph

The larvae became protonymphs after undergoing the first moult. At this stage the nymphs had four pairs of legs and the sexes were easily distinguishable. The female was broader than the male with a swollen body. The male appeared flat and narrow and developed more quickly. Different food did not significantly influence the protonymphal duration, and the mites moulted for the second time after about 7 days to become the deutonymphs. These deutonymphs continued feeding and developing on the leaf sap and honey without showing any predaceous habit. No marked difference in the rate of deutonymphal development was apparent with the change of food in different cages, and the nymphs became adults after 8 to 9 days with the different food substances provided. Average body measurements of this stage are given below.

Stage	Sex	Length (mm.)	Breadth (mm.)
Protonymph	♂	0·246	0·153
	♀	0·267	0·064
Deutonymph	♂	0·288	0·174
	♀	0·308	0·185

Adult

The body colour of *A. finlandicus* did not change at any stage of the life history. However, females preying on *P. indicus* appeared brown. The body measurements were, male—0·328×0·200 mm. and female—0·349×0·236 mm. The adult mites displayed varied food habits. They fed on the leaf sap, honey and also preyed upon the Tetranychid in the rearing cages. The effect of different food on the rate of reproduction and adult longevity was distinctly evident. As shown in Table 1, individuals fed with honey or the prey mites or a combination of both lived much longer than those fed on sugarcane leaf. With the spider mite in the diet the phytoseiid adults lived for 12 to 17 days; and adding honey to the food increased the longevity by 3 to 4 days. Honey was found to provide the required nutrition and prolonged the laying and post-laying periods of the female imago.

The egg-laying capacity of this species was found to be poor. A single fertilized female nourished on sugarcane leaf or honey did not lay more than 5 eggs during its life time. However, when both the prey mite and honey were made available, each female laid more than three times the number of eggs than what was laid with sugarcane leaf plus honey as food. In cages where *P. indicus* mites were provided along with sugarcane leaf, the phytoseiid readily preyed upon the former, and the reproductive rate was decreased by one half than

TABLE 2

FLUCTUATIONS IN FIELD POPULATIONS OF *A. finlandicus* AND *P. indicus* IN SUGARCANE VARIETIES

Sugarcane variety	Mean number of mites per 10 leaves											
	August		September		December		January		April		May	
	A.f.	P.i.	A.f.	P.i.	A.f.	P.i.	A.f.	P.i.	A.f.	P.i.	A.f.	P.i.
Co. 6403 ..	10·8	3·1	11·3	2·7	8·5	2·2	18·0	2·4	9·2	55·5	12·5	50·1
Co. 6407 ..	8·6	1·8	10·3	1·3	11·8	2·6	11·0	1·8	7·5	70·8	8·5	49·2
Co. 62022 ..	14·4	4·5	13·0	2·7	15·0	3·8	16·2	1·4	9·5	65·5	11·5	52·5
Mean Temp. °C. ..	28·9		28·5		20·6		20·7		30·5		32·7	
R.H. % ..	86		82		64		72		62		63	

A.f. :—*A. finlandicus* P.i. :—*P. indicus* what was seen with a combination of all three food substances. Thus it was evident that inclusion of the prey mite and honey had some stimulating effect which increased adult longevity and rate of reproduction of the Phytoseiid mite.

Mating behaviour:

As soon as the female completed the nymphal development, mating took place. Often more than one male attempted to mate with a female and finally one quickly climbed over the female. Soon after it slipped underneath the female body and mated by attaching itself to the ventral side of its partner. The process of mating continued for 25 to 30 seconds after which they separated. Both males and females mated several times.

Egg-laying started 1 to 2 days after mating, and more than 90% of the eggs deposited by fertilized females hatched into larvae. Out of 30 larvae kept under observation, 11 developed as males and 19 as females.

Field observations

A. finlandicus was active in the field throughout the year. The fluctuations in the population levels of this species and its prey *P. indicus* were carefully observed on 3 sugarcane varieties during the wet, cold, and summer months.

From the data presented in Table 3 no definite predator-prey relationship between the phytoseiid and the tetranychid was evident. During the summer months the prey species was most numerous in the field with a mean number varying between 50·1 and 70·8 mites per 10 sugarcane leaves examined at random. On the other hand, the number of *A. finlandicus* for the same unit sample did not exceed 12·5. In the other two seasons the situation was somewhat reversed. December and January provided most favourable conditions for the phytoseiid with temperature varying between 20·6° and 20·7°C, and R.H. 64 and 72%. Co 6403 and Co 62022 cane varieties recorded as high as 18 and 16·2 mites per 10 leaves respectively even though the number of *P. indicus* varied between 1·4 and 3·8 per 10 leaves. However, in August and September some kind of balance in population densities of the predatory phytoseiid and its tetranychid prey species was apparent. High atmospheric temperature of 30·5 to 32·7°C and R.H. 62 to 63% appeared detrimental for the rapid multiplication of *A.*

finlandicus although, such environmental conditions were found to be most favourable for the spider mite *P. indicus*.

ORISSA UNIVERSITY OF AGRICULTURE
AND TECHNOLOGY,
BHUBANESWAR,
ORISSA,
May 3, 1968.

J. M. SATPATHY
P. K. MANIA

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23. *PHYLLANTHUS MUKERJEEANUS* MITRA & BENNET— NEW RECORD FOR ORISSA STATE

This species was described in the year 1967 (*Bull. Bot. Soc. Bengal* **19**: 145) from a collection made from Howrah District, W. Bengal on 3-iv-1964. Since then it has not been recorded from any other place. Recently a collection of this species by V. Abraham (No. 327, dated 20-iv-1965) from Puri, was found in Botanical Survey of India Herbarium. *P. mukerjeeanus* is closely allied to *P. debilis* Willd.; but distinguished mainly by the presence of leaves on main stem and primary branches, the seeds are hairy with 8-10 longitudinal ribs, whereas in *P. debilis* the main stem and primary branches are without leaves, and the seeds smooth with 6-7 longitudinal ribs on the back.

BOTANICAL SURVEY OF INDIA,
CALCUTTA-14,
February 20, 1969.

S. S. R. BENNET

24. *CANSCORA CONCANENSIS* C. B. CL. IN MAHARASHTRA
(*With a plate*)

Canscora concanensis C. Clarke, which is apparently endemic in western India, was originally described by C. B. Clarke (1883) based on a single specimen, collected by Law sometime during 1840-50 from Concan, without precise locality. Cooke (1905) also cited the same sheet, now available at Kew herbarium. It appears that the species has not so far been collected by later workers, except a very recent record from Pavagadh Hill, Gujarat State (*J. Bombay nat. Hist. Soc.* **65** (2): 523, 1968) where a mention is made of the plant.

During studies on the Flora of Maharashtra State, the species has been collected after a gap of about 120 years, from Shahapur and Kasara Reserve Forest (Thana District) and Peint area (Nasik District) growing in abundance in grasslands.

Detailed description and a diagram are given here to facilitate other workers identify the species in other parts of Western India.

Canscora concanensis C. Clarke in *Fl. Brit. India* **4**: 104, 1883; Cooke, *Fl. Pres. Bombay* **2**: 258 (reprint).

Annual, erect, branched herb up to 22 cm. tall. *Stem* quadrangular, obscurely winged. *Leaves* opposite, membranous, 3-nerved, sessile, upper ovate, acute, base rounded, lower elliptic, acute, attenuated at the base, 1·6-2·6×0·6-1·7 cm. *Inflorescence* weak, terminal, dichotomous cyme; flowers pedicellate, pedicel filiform, 0·5 cm. long; bracts small, linear lanceolate; calyx 1 cm. long, tubular, 4-toothed, winged, wing 0·2-0·4 cm. broad, membranous, elliptic, reticulately veined; corolla bluish-purple, imbricate in bud, tube as long as the calyx, lobes obovate; stamens 4; stigmas 2. *Capsule* oblong, elliptic, 2-valved, 0·5 cm. long; seeds numerous, minute, ovoid, finely reticulate.

Habitat: Frequently found growing along with *Torenia cordifolia*, *Smithia conferta*, *Lobelia trigona* and *Lindernia* sp.

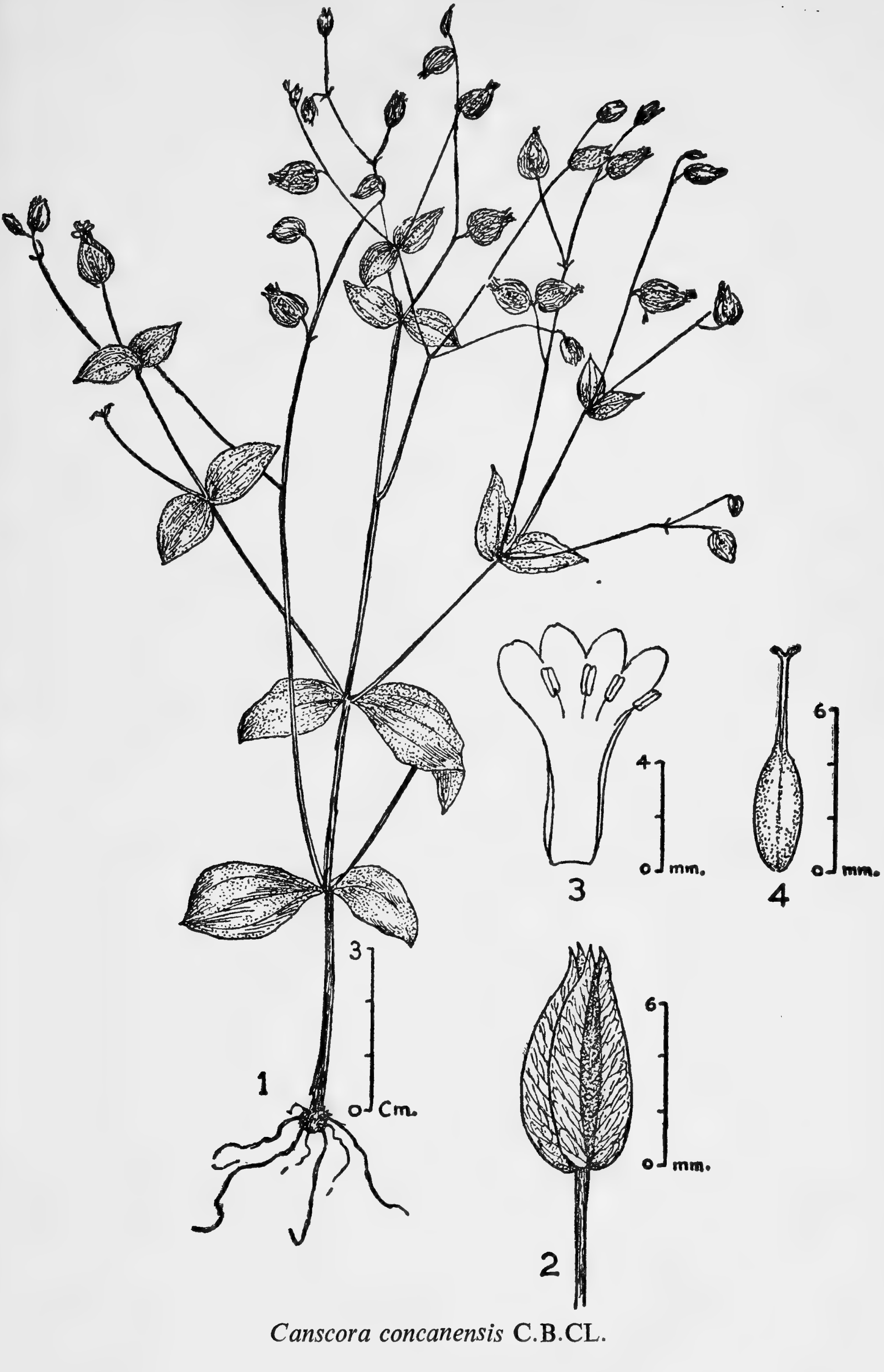
The plant seems to be ephemeral, flowering and fruiting during the later part of monsoon, mainly in September and dying off quickly. Probably this is the reason why it has escaped attention of earlier field workers. Even with the isolated record of the species from Pavagadh of Gujarat State and from Thana and Nasik districts of Maharashtra State, its distribution may for the present, be assumed as extending along the Sahyadris and the adjoining hilly ranges.

Specimens collected:

Shahapur, Thana Dist. *Rolla* 81515, 16-9-1961; Kasara Reserve Forest, Washala Forest Range, Thana Dist. *Billore* 116790, 20-9-1968; Peint, Nasik Dist. *Cherian* 111320, 12-9-1967; Kumbhale, Peint area, Nasik Dist. *Cherian* 111583, 22-9-1968.

Acknowledgements

We are thankful to Shri R. S. Rao, Regional Botanist, Western Circle, Botanical Survey of India, for encouragement and



Canscora concanensis C.B.CL.

1. Whole plant. 2. Fruit showing winged calyx. 3. Corolla showing attachment of stamens. 4. Gynoecium.

guidance and to the Director, Royal Botanic Gardens, Kew, for confirming the identification.

Botanical Survey of India,
Western Circle,
Poona,
February 3, 1969.

(Miss) K. K. AHUJA
P. J. CHERIAN

25. NEW PLANT RECORDS FOR SOUTH INDIA—IV

The occurrence of four more species of plants so far not recorded in south India is reported in this paper.

Biophytum proliferum (Arn.) Wt. in Wight, III. **1**: 168, 1840. (Geraniaceae)

Wight (1840) reported this species from 'Ceylon, in woods'. Edgeworth and Hook. f. (1882) in Hooker's FLORA OF BRITISH INDIA mention the collections of Walker, Gardner and others at 6000 feet elevation in Ceylon.

Arnott described this species originally as *Oxalis prolifera* (Nov. Act. Acad. Caes. XVIII, 327), which Wight in his ILLUSTRATIONS OF INDIAN BOTANY brought under *Biophytum*. Edgeworth and Hook. f. dealing with this species have mentioned the inflorescence as usually one-flowered and the leaflets as 'usually glabrous above'. But Arnott described the umbels as 2-5-flowered and the leaflets as pilose above. The specimens in the Madras Agricultural College Herbarium show the characters as described in this note below; the Madurai collections are a little more hairy than the Tirunelveli collections.

Description: A well branched species with decumbent, slender, pubescent branches; leaves in whorls rarely over 2·5 cm. long; leaflets small, 3-5 mm. in length, 8 to 14 pairs, oblong-oblique, cuspidate, glabrous to very sparsely hairy above, pilose below; flowers one to few on pubescent slender peduncles much shorter than the leaves; pedicels very short, slender, hairy; sepals hairy, acute; petals glabrous; capsules enclosed within the persisting calyx; seeds minute, tubercled.

Collected at, Madurai District: Kodaikanal to Madurai, *K. Rangachari* 4508, 24th July, 1920. Madras Agricultural College; Tirunelveli District: Mahendragiri, *K. Rangachari* 4507, 18th September, 1916, Madras Agricultural College.

Clausena excavata Burm. f. Fl. Ind. 87, 1767. (Rutaceae)

This is a tropical species with distribution from Himalayas altitude 2000 feet, Nepal (*Wallich*), Bhutan (*Griffith*), Silhet, Pegu and Chittagong (*Wallich* etc.), Eastern Peninsula, Malacca (*Griffith*), Penang (*Porter* etc.), Sumatra, Java, Borneo according to Hooker (1872) in FLORA OF BRITISH INDIA. Haines (1921) in the BOTANY OF BIHAR AND ORISSA mentions that this species is common in the Sal forests. It appears to be a very variable plant ranging in size and growth depending on distribution. Haines records it as an undershrub attaining only 1·5 to 2 feet and dying down annually to the root-stock. Kurz (1877) in the FOREST FLORA OF BRITISH BURMA describes it as an ever-green shrub, rarely growing out into a little tree of 10-15 feet high. But Roxburgh, FLORA INDICA **2**·250-251, 1832, states that the plant introduced at the Botanic Garden at Calcutta from Sumatra had grown to the height of twenty feet, with a long, perfectly straight trunk, in five years.

Record of this species has not so far been made in south India. There is one specimen collected by V. Narayanaswamy at Arambha in Travancore on 5-xi-1928; though the specimen by itself is incomplete, it has been determined by Narayanaswamy at Calcutta as *C. excavata* Burm.

Description. A small tree or shrub, strongly scented; branches tomentose, leaves 15-30 cm. long, alternate, imparipinate; leaflets 7-15, ovate to oblong-lanceolate, obscurely crenate, membranous, base oblique, apex acuminate; inflorescence a terminal panicle, pyramidal; flowers shortly pedicelled, 0·5 cm. in diameter; petals oblong; glabrous; stamens eight, yellow; fruits broadly oblong, 1-2-seeded.

V. Narayanaswamy 4510, Arambha, Travancore, on 5th November, 1928. Madras Agricultural College.

Desmodium tortuosum (Sw.) DC. Prod. **2**:332, 1825. (Papilionoideae).

Syn. *D. stipulaceum* DC., *D. pedicellatum* Grah., *D. pulcherrimum* Shuttlew.

Grisebach (1864) in his FLORA OF THE BRITISH WEST INDIAN ISLANDS, gives its distribution as Jamaica, Dominica, Cuba, Guadeloupe, Florida, Mexico, New Granada, and as naturalised in East Indies.

Description. Herbaceous erect plant, reaching 45-60 cm.; stem striate, cylindrical, base suffruticose, hispidulous; leaves compound, pinnately trifoliar, leaflets entire, elliptic, glabrous, mucronate, petioles shorter than the leaf, slender, hispidulous, channelled above, stipules obliquely subulate, prominently ribbed, ribs 7-9, margins ciliate;

inflorescence lax racemes, simple elongate, pedicel filiform, longer than the flower; lomentum sub-sessile, uncinnate-pubescent with persistent calyx, tortuous, at length flattened, articulated nearly to the centre, joints 1 to 5, orbicular, flat.

This American and West Indian species has been collected for the first time in south India at Mundanthurai, Tirunelveli District, by K. C. Jacob on 8th February, 1921 (Madras Agricultural College Herbarium, No. 4509) and again in the wetlands of the Agricultural College, Coimbatore, by K. C. Jacob on 15th November, 1936. (Madras Agricultural College Herbarium, No. 4512).

Desmodium velutinum DC. Prod. **2**:328, 1825. (Papilionoideae) America-Australia.

A very striking plant with tawny velvety hairs on stems, petioles and inflorescence, but greyish velvety on the lower surface of leaves. The inflorescence is also characteristic with slender and long peduncle and comparatively much smaller flowers arising in clusters. This species has been collected from grass lands at an elevation of about 3000 feet.

Description. Herbaceous, densely clothed with velvety pubescence; stem fruticose, cyclindrical, pubescent; leaves alternate, entire pubescent, ovate, apex mucronate; petioles shorter than the leaf, pubescent; stipules minute, caducous; inflorescence terminal or axillary racemes, peduncle densely villose; flowers very small, pedicel stout, much shorter than the flowers; bracts, bracteoles and calyx villous; lomentum compressed, articulated, joints oblong villous tomentose. This species was collected by Narayanaswamy at Ponnemodu, Travancore, on 14th November 1928 (Madras Agricultural College Herbarium, No. 4511).

AGRICULTURAL COLLEGE AND
RESEARCH INSTITUTE,
COIMBATORE-3,
February 20, 1969.

D. DANIEL SUNDARARAJ
M. NAGARAJAN

26. SOME INTERESTING PLANT RECORDS FROM THE ORISSA COAST

During ecological studies on the Orissa coast two interesting plants collected near Chandipur and Paradip shores on identification were found to be new records not previously reported from Orissa. A brief note on them is presented here.

Myriostachya wightiana (Nees ex Steud) Hook. f.

A stout, tufted, perennial grass with a short, stout, spongy rhizome, narrow flat blades, and spikelets distichously racemed in narrow elongated panicle. This tall grass was collected near Paradip shore along the edges of several saline creeks of the estuarine ecosystem. It grows in dense almost pure stands. Sometimes in association with *Oryza coractata* Roxb.

In India it is reported from Sundariban (West Bengal), Andhra and Madras coasts. Outside India it is reported along the coasts of Tenasserim, Malaya, Siam and Indo-China.

Bati Ghar (Light House), Paradip, *L. K. Banerjee* 571, 2-ix-1968.

Cyperus esculentus L.

This sedge is characterised by its zoned swollen tubers and outwardly radiating stolons lying only just below the surface of the mud which often give rise to new plantlets. This forms a dense gregarious patch along those parts of the banks of the Burabalanga (Chandipur) and the Mahanadi (Paradip) falling under tidal influence. It was found to be abundant at the lower reaches and less in upper reaches. This evidently shows that this plant tolerates the rather more saline habitat in the lower reaches. Its inland distribution in wet areas in other parts of India is well known. In Orissa, its occurrence is reported for the first time.

Balaramgudi/Chandipur, estuarine banks of the Burabalanga River, *A. K. Mukherjee* 6022, 27-x-1967.

Kujang, Tidal banks of the Mahanadi River, *L. K. Banerjee* 491, 30-viii-1968.

ECCOLOGY SECTION,
BOTANICAL SURVEY OF INDIA,
76-ACHARYA J. C. BOSE ROAD,
CALCUTTA-14,
March 5, 1969.

T. ANANDA RAO
L. K. BANERJEE
A. K. MUKHERJEE

27. *HELIOTROPIUM CURASSAVICUM* LINN.: AN ADDITION TO THE FLORA OF NORTHERN INDIA

During my survey of the vegetation of Delhi State and its neighbourhood, spread over five consecutive years (1964-1969), I found *Heliotropium curassavicum* Linn., (family Boraginaceae) growing wild in saline soils at some places like Palwal, Hoda Ballabhgarh and University Campus.

The plant is a prostrate annual with a woody root-stock. The aerial parts are glabrous, glaucous and fleshy. Leaves are whitish, linear to spathulate and obovate-lanceolate; 1 to 2 cm. long; apex acute to mucronate. Flowers are small, in terminal scorpioid cymes. Corolla white with yellowish centre. Nutlets glabrous.

It is a winter annual; the seedlings appear after rains during early part of October and flourish till early April. Its associates are: *Chenopodium album, Glinus lotoides, Salsola foetida* and *Tamarix dioica.*

Commonly known as Chinese pugsley, Quail plant etc., this taxon is native to the saline soils of the U.S. (see Bailey, L.H. 1950: *Stand, Cyclop. Hortic.*, vol. 11; Kearney, T.H. *et al.* 1960: *Fl. Ariz.*; Jepson, W.L., 1963: *Man. Fl. Pl. California.*). It is not mentioned by Hooker in FLORA OF BRITISH INDIA, and there is no previous record of its occurrence in north India. Gamble (in FLORA OF MADRAS) reported its occurrence from Coromandel coast on salt back-waters as at Madras, Vizagapatnam, Tuticorin'. He also indicated that it is 'introduced probably from West Indies'.

DEPARTMENT OF BOTANY,
UNIVERSITY OF DELHI,
DELHI-7,
April 14, 1969.

K. M. M. DAKSHINI

28. A NOTE ON *SONERILA ARGUTA* R. BR. EX NAUD. (MELASTOMATACEAE)

(*With a plate*)

Sonerila arguta R. Br. ex Naud. has been recorded by Clarke (1879) in J. D. Hooker's FLORA OF BRITISH INDIA from 'Khasi Mts., alt. 3000-4000 ft.', as collected by *Wallich, Hk. & T., C.B. Clarke.* Kanjilal *et al.* (1938) have, however, not included it in their FLORA OF ASSAM. The species is endemic to the region of Assam. Even there it appears to be very rare in occurrence as two old specimens, both collected by Sir J. D. Hooker and T. Thomson from Khasia Mountains, 3000 ft., sheet nos. 173096 and 173098, are the only ones which could be found represented in Central National Herbarium, Calcutta. The authors are not aware of any other specimens lying in other herbaria of India nor have they come across any mention of the species in any recent publications on the botany of Assam region.

A few years back this species was observed by one of us (S. L. Kapoor) growing abundantly on a wet, shady, slope near a stream, in a rather out-of-way place on Pynursla-Dawki Road in Khasi Hills.

As the description included in FLORA OF BRITISH INDIA needs to be supplemented with regard to measurements and other features, the species is described in detail and also illustrated.

Sonerila arguta R. Br. ex Naud. *Ann. Sc. Nat. Ser.* 3. 15:326. 1851.

A delicate, about 3·5-5·5 cm. tall herb. Stems 0-5 cm. Leaves simple, crowded. petiolate, elongate-spathulate or oblanceolate, shortly acuminate or acute, attenuated at the base, 1·5-10 cm.×0·4-0·85 cm., minutely denticulate or serrulate at the margin, chartaceous, one-nerved, with scattered large white hairs (turning light brown in dried specimens) above. glabrous beneath; petiole jointed on a tubercle of the stem, supported on each side by a rufous, up to 0·3 cm. long bristle. Flowers solitary, light or pinkish purple; peduncles 3-5 cm. long, glabrous. Calyx tube up to 0·4 cm. long, long-funnel-shaped, shortly 3-toothed, glabrous. Petals 3, elliptic, abruptly acute or nearly acuminate at the apex, entire, nerve pattern conspicuous, upto 0·8 cm. ×0·8 cm., glabrous on both the surfaces. Stamens 3, up to 1·2 cm. long (including filaments) glabrous; anthers 2-celled, introrse, basifixed, attenuate at top, shortly divaricate at base, dehiscing by an apical pore. Pistil up to 1·1 cm. long, glabrous; style simple, filiform; stigma truncate. Capsule 0·6-0·95 cm. long, elongate-funnel-shaped, glabrous, subtrigonous, ribs obscure, opening at the top by 3 valves, calyx persistent in fruit. Seed obovoid, with minute raised points, raphe not excurrent.

Flowering and fruiting: September-October.

The following sheets have been seen. Near Pong-tung Village, about 5·6 km. on Pynursla-Dawki Road, K. & J. Hills, Assam, 725 m., 5-x-1962, fl. and fr., *S. L. Kapoor & Party* 75573 (LWG).

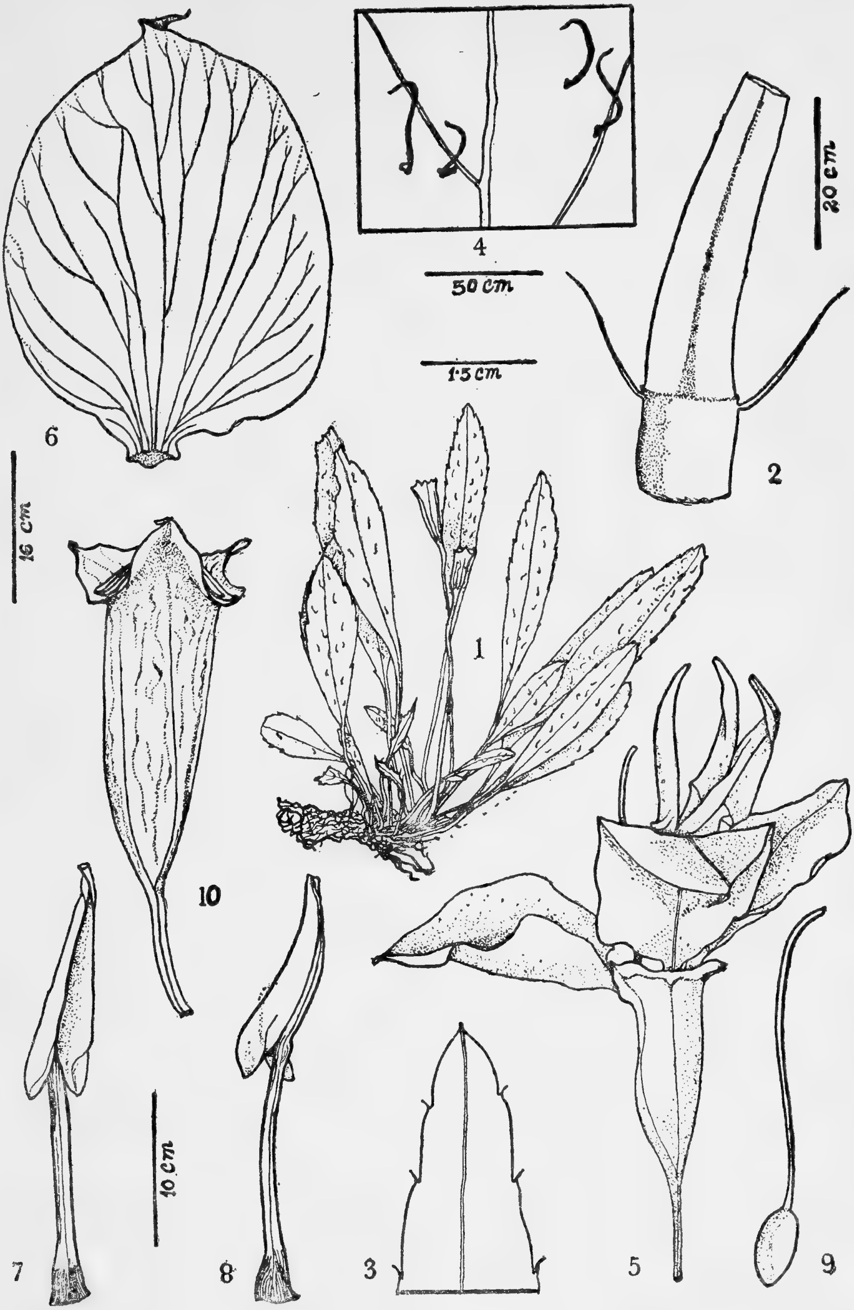
ACKNOWLEDGEMENTS

We are thankful to the Director, National Botanic Gardens, Lucknow, for providing facilities and to the Director, Botanical Survey of India, Calcutta, for permission to consult the Calcutta Herbarium. Thanks are due to Dr. L. D. Kapoor for going through the manuscript.

NATIONAL BOTANIC GARDENS,
LUCKNOW,
May 1, 1969.

MOHAMMAD ASLAM
S. L. KAPOOR

Aslam & Kapoor: *Sonerila arguta*



Sonerila arguta R. Br. ex Naud.

1. Plant; 2. Tubercle of stem with rufous bristles and part of petiole; 3. Part of leaf (lower surface) showing apex and margin; 4. Part of leaf (upper surface); 5. Flower with a part of peduncle; 6. Petal (inner-face); 7. Stamen (front view); 8. Stamen (lateral view); 9. Pistil; 10. Fruit.

29. ON *CUSCUTA REFLEXA* ROXB. IN GWALIOR, M.P.

The parasitism of *Cuscuta reflexa* Roxb., a leafless total parasite belonging to sub-genus Monogyna of *Cuscuta* Linn. family Convolvulaceae, has been worked out by various workers from India: Thoday, 1911; Rao, 1938, 1963; Kachroo, 1951; Sheriar, 1951; Narayan, 1956; Santapau & Patel, 1957; Sen, 1959; Chavan and Sabnis, 1960; Gupta, 1960; Prasad, 1966. They have found that *Cuscuta reflexa* Roxb., *C. hyalina* Roth. and *C. chinensis* Lamk. show 'diffuse type' of parasitism and occur on a number of different hosts belonging to Angiosperms, Gymnosperms and Pteridophytes.

The principal hosts of *Cuscuta reflexa* Roxb. are different in different parts of the country; for example, *Clerodendrum inerme* Gaertn. in Bombay, *Duranta repens* Linn. Khasi hills and Bihar, *Adhatoda vasica* Nees in Alwar and *Lantana camara* Linn. var. *aculeata* (Linn.) Mold. in Bihar. In Gwalior the principal hosts are *Dalbergia sissoo* Roxb. and *Adhatoda vasica* Nees.

Various workers have recorded it on about 90 different hosts. During the course of the present study, 1967-68, the author has collected 42 hosts of *C. reflexa* Roxb. from the neighbourhood of Gwalior. As far as is known, plants marked with an asterisk are here listed as hosts of *C. reflexa* Roxb. for the first time.

Principal (P), Secondary (S) and Minor (M) categories of hosts have been recognised on the basis of intensity of attack by parasite on hosts. The specimens have been deposited in the Dept. of Botany, Govt. Science College, Gwalior.

LIST OF HOST SPECIES OF *Cuscuta reflexa* ROXB. IN GWALIOR

Sl. No.	Host species	Category of host	Parts attacked by parasite
1.	*Sida veronicaefolia* Lamk.	S	Stem & leaves
2.	*Hibiscus micranthus* Linn.	S	Stem
*3.	*Bombax ceiba* Linn.	S	Stem & leaves
4.	*Corchorus trilocularis* Linn.	S	,, ,,
5.	*C. tridens* Linn.	S	Stem, leaves & fruits
*6.	*Azadirachta indica* A. Juss.	S	Stem & leaves
7.	*Zizyphus mauritiana* Lamk.	S	,, ,,
8.	*Z. nummularia* Wt. & Arn.	M	,, ,,
9.	*Cardiospermum halicacabum* Linn.	M	Stem
*10.	*Rhynchosia minima* DC.	S	,,
*11.	*Teramnus labialis* Spreng.	S	Stem & leaves
12.	*Dalbergia sissoo* Roxb.	P	,, ,,
13.	*Cassia siamea* Lamk.	S	,, ,,

LIST OF HOST SPECIES OF *Cuscuta reflexa* ROXB. IN GWALIOR (*contd*).

Sl. No.	Host species	Category of host	Parts attacked by parasite
14.	*Acacia leucophloea* Willd.	M	Stem
15.	*A. nilotica* (L.) Del. subsp. indica Bren.	S	Stem & leaves
16.	*Lawsonia inermis* Linn.	S	Stem
*17.	*Bryonopsis laciniosa* Naud.	M	,,
18.	*Melothria maderaspatana* Cogn.	S	,,
19.	*Vernonia cinerea* (Linn.) Less.	S	,,
20.	*Xanthium strumarium* Linn.	S	Stem, leaves & fruits
21.	*Tridax procumbens* Linn.	M	Stem, peduncles & leaves
*22.	*Calotropis procera* (Ait.) R. Br.	M	Stem
*23.	*Pergularia daemia* (Forsk.) Blatt. & McC.	M	,,
24.	*Ipomoea pestigridis* Linn.	M	,,
25.	*Lycopersicon esculentum* Mill.	M	,,
26.	*Adhatoda vasica* Nees	P	Stem, leaves & inflorescence
27.	*Andrographis echioides* (L.) Nees	S	Stem
28.	*Peristrophe bicalyculata* Nees	S.	,,
29.	*Lantana camara* Linn. var. *aculeata* (Linn.) Mold.	M	,,
*30.	*L. indica* Roxb.	M	,,
*31.	*Boerhavia repanda* Willd.	S	Stem & leaves
32.	*Achyranthes aspera* Linn.	S	Stem, leaves & inflorescence
33.	*Euphorbia hirta* Linn.	M	Stem
*34.	*Emblica officinalis* Gaertn.	M	Stem & leaves
35.	*Holoptelea integrifolia* (Roxb.) Planch.	S	,, ,,
*36.	*Commelina benghalensis* Linn.	S	Stem, leaves & spathes
*37.	*C. forskalii* Vahl	M	Stem
*38.	*Cyperus rotundus* Linn.	M	Leaves
39.	*Dichanthium annulatum* Stapf	M	Leaves & stem
40.	*Cynodon dactylon* Linn.	M	,, ,,
41.	*Apluda mutica* Hack.	M	Stem
*42.	*Saccharum spontaneum* Linn.	M	Leaves

ACKNOWLEDGEMENTS

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DEPT. OF BOTANY,
GOVT. SCIENCE COLLEGE,
GWALIOR, M.P.,
November 30, 1968.

J. P. KAUSHIK

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30. AN ENUMERATION OF CHLOROCOCCALES OF GUJARAT

Our knowledge about Chlorococcales of Gujarat is mostly through the works of Kamat (1962), Patel & Shah (1965), Patel (1966) and Patel & Francis (in press). In the present paper therefore 31 plants of the order Chlorococcales are listed with a view to fill up the existing gap about the information on this group of algal flora of Gujarat. The identification of plants has been made with the help of literature available such as that of West (1904), Pascher (1915), Prescott (1951) and Tiffany et Britton (1952). The plants reported by earlier workers are marked with an asterisk in the text.

The numbers and letters in the text stand for the bottle numbers from which the species are identified. The plants enumerated in this paper are in the Department of Botany, Sardar Patel University, Vallabh Vidyanagar.

CHARACIACEAE

Characium braunii Bruegger.

Gomati Pond, Dakor, Kaira Dist. 13-ix-'65, *Patel* 768.

HYDRODICTYACEAE

Hydrodictyon reticulatum Roth.

River Balaram, near Palanpur, North Gujarat. 19-xii-'65, *Patel* 792; Mesari River, Valavao, Baroda Dist. 4-x-'66, *Patel* 1056.

* **Pediastrum duplex** Meyen.

Shedhi River, near Nadiad, Kaira Dist. 4-viii-'57, *Patel* 403.

P. duplex var. **reticulatum** Lagerheim.

Ditches near Engineering College, Vallabh Vidyanagar. 10-viii-'65, *Patel* 750.

P. duplex var. **gracilimum** West et West.

Ditches near Engineering College, Vallabh Vidyanagar. 10-viii-'65, *Patel* 750.

P. duplex var. **clathratum** (A. Braun.) Lagerheim.

Shedhi River, near Nadiad, Kaira Dist. 4-viii-'57, *Patel* 403.

P. biradiatum Meyn.

Mesari River, Valavao, Baroda Dist. 22-x-'64, *Patel* 614.

P. integrum Naegeli.

Mesari River, Valavao, Baroda Dist. 22-x-'64, *Patel* 614.

P. constrictum Hassel.

Mesari River, Valavao, Baroda Dist. 22-x-'64, *Patel* 629.

* **P. tetras** (Ehrenberg) Ralfs.

Mesari River, Valavao, Baroda Dist. 22-x-'64, *Patel* 629.

P. tetras var. **obtusata** Raciborski.

Mesari River, Valavao, Baroda Dist. 22-x-'64, *Patel* 629.

P. bidentulum A. Braun.

Mesari River, Valavao, Baroda Dist. 22-x-'64, *Patel* 614.

P. bidentulum var. **ornatum** Nordstedt.

Mesari River, Valavao, Baroda Dist. 22-x-'64, *Patel* 629.

P. clathratum var. **microporum** Lemmermann.

Gangda pond, Valavao, Baroda Dist. 22-xi-'52, *Patel* 131.

P. simplex (Meyen.) Lemmermann.

Mahi River, Galteshwar, Kaira Dist. 30-ix-'65, *Patel* 787.

P. simplex var. **duodenarium** (Bailey.) Rabenhorst.

Ditches on the way to Manchi, Pavagadh, Panchmahal Dist. 4-ix-'66, *Patel* 1060.

P. simplex var. **granulatum** Lemmermann.

Mahi River, Galteshwar, Kaira Dist. 30-ix-'65, *Patel* 787.

P. boryanum var. **perforatum** Raciborski.

Gangda pond, Valavao, Baroda Dist. 22-xi-'52, *Patel* 131.

Sorastrum spinulosum Naegeli.

Shedhi River near Nadiad, Kaira Dist. 4-viii-'57, *Patel* 403.

COELASTRACEAE

*I **Coelastrum microporum** Naegeli.

Shedhi River near Nadiad, Kaira Dist. 4-viii-'57, *Patel* 403.

C. reticulatum (Dang.) Sann.

Mahi River, Galteshwar, Kaira Dist. 30-ix-'65, *Patel* 787.

OOCYSTACEAE

Dictyosphaerium pulchellum Wood.

Ditches near Engineering College, Vallabh Vidyanagar. 10-viii-'65, *Patel* 750.

Dimorphococcus lunatus A. Braun.

Ditches on the sides of Anand-Bhalej Road near Gamdi, Kaira Dist. 8-viii-'65, *Patel* 749.

Ankistrodesmus spiralis Lemmermann.

Ditches near railway line, Vallabh Vidyanagar. 19-viii-'64, *Patel* 538.

* **A. falcatus** (Corda) Ralfs.

Pond, Limbasi, Kaira Dist. 27-iii-'65, *Patel* 693.

Selenastrum westii Smith.

Ditches near railway line, Vallabh Vidyanagar. 19-viii-'64, *Patel* 538.

Kirchneriella obesa (W. West) Schmidle.

Ditches near railway line, Vallabh Vidyanagar. 7-viii-'65, *Patel* 711.

Tetraëdren pusillum (Wallich.) West et West.

Ditches near Engineering College, Vallabh Vidyanagar. 10-viii-'65, *Patel* 750.

T. minimum (A. Braun) West et West.

Ditches near Engineering College, Vallabh Vidyanagar. 10-viii-'65, *Patel* 750.

T. trigonum var. **gracile** (Reinsch.) De Toni.

Ditches near Engineering College, Vallabh Vidyanagar. 10-viii-'65, *Patel* 750.

Scenedesmaceae

Scenedesmus bijuga var. **alternans** (Reinsch.) Hansgirg.

Mesari River, Valavao, Baroda Dist. 22-x-'64, *Patel* 629.

S. dimorphus (Turp.) Küetzing.

Ditches near railway line, Vallabh Vidyanagar. 19-viii-'64, *Patel* 638.

S. abundans var. **brevicauda** Smith.

Mahi River, Galteshwar, Kaira Dist. 30-ix-'65, *Patel* 787.

* **S. longus** Meyen.

Ditches near Engineering College, Vallabh Vidyanagar. 10-viii-'65, *Patel* 750.

S. serratus (Corda) Bohlin.

Shedhi River near Nadiad, Kaira Dist. 4-viii-'57, *Patel* 403.

Crucigenia lauterbornei Schmidle.

Ditches near Jaria pond, Vallabh Vidyanagar. 12-ix-'65, *Patel* 765.

Protosiphonaceae

Protosiphon botryoides (Kütz.) Klebs.

Drying up ditches near Kala Kendra, Vallabh Vidyanagar. 10-viii-'67, *Patel* 'Y'.

ACKNOWLEDGEMENT

Thanks are due to Dr. R. N. Singh for facilities and useful literature in his laboratory, Banaras Hindu University, Varanasi.

DEPARTMENT OF BOTANY,
SARDAR PATEL UNIVERSITY,
VALLABH VIDYANAGAR,
KAIRA DIST., GUJARAT.

R. J. PATEL

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ANNUAL REPORT OF THE BOMBAY NATURAL HISTORY SOCIETY FOR THE YEAR 1968-69

Executive Committee

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Dr. P. V. Cherian, *Governor of Maharashtra*

Vice-Presidents

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Dr. Sálim Ali, D.SC., F.N.I.
Rev. Fr. H. Santapau, S.J.

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Mr. Zafar Futehally

Hon. Treasurer

Mr. J. D. Kapadia, I.C.S. (Retd.)

Member

Secretary, Ministry of Education, Govt. of India

ex-officio

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Mr. Humayun Abdulali
Mr. G. V. Bedekar, I.C.S. (Retd.)
Prof. P. V. Bole
Mr. S. Chaudhuri
Mr. R. E. Hawkins
Dr. C. V. Kulkarni, M.SC., Ph.D.
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HONORARY SECRETARY'S REPORT FOR THE YEAR 1968

MEMBERSHIP

The total number on our register as on 31st December, 1968 was 894 including 151 life members, 2 honorary members and 63 forest department nominees and 1 student member, who receive the journals at a concessional rate. During the year, 79 ordinary members, 3 new life members and 3 compounded life members joined as against 48 ordinary members and 3 life members resigned or died. Among the 677 ordinary members 638 members have paid the subscription for the year and we have to receive subscription for 1968 from 39 members. In accordance with rule 14 of the rules and regulations members in arrears for over two years have been sent a letter requesting them to continue their membership, and if it was not possible to inform us accordingly.

Attention is drawn to the fact that the number of ordinary members has remained static for the last several years and this is a very unsatisfactory state of affairs. We appeal to you for help in enrolling interested persons, for unless more members are enrolled it will be difficult for the Society to continue with its activities.

	as on 31-12-1968	31-12-1967
Ordinary Members	677	620
Life Members	151	138
Forest Department Nominees ..	63	53
Student Member	1	1
Honorary Members	2	2
	894	814

THE SOCIETY'S PUBLICATIONS

Journal : Three numbers of the Journal were published during the year, Volume **64**(3) and Volume **65** Nos. 1 and 2. The 740 pages include 6 articles each on birds and insects, 5 on botany, 4 each on wild life and fishes, 4 on other invertebrates, 3 on crustacea, 2 on General Natural History, and 1 on mammals. The 90 miscellaneous notes published in these numbers cover all aspects of Indian Natural History.

Newsletter : During the year we had to stop publication of the Society's Newsletter HORNBILL owing to the all round increase in costs. Many members, however, have expressed their regret that this has been discontinued, and every attempt will be made by the Executive Committee to revive it as soon as funds can be found.

Books : The 8th edition of the BOOK OF INDIAN BIRDS by Sálim Ali was published during the year. The first volume of the HANDBOOK OF

THE BIRDS OF INDIA AND PAKISTAN by Sálim Ali and Dillon Ripley was published during the year by the Oxford University Press. The Handbook is sponsored by our Society ; Vol. 2 has since been published and work on the 8 subsequent volumes is in progress.

Attempts are being made to find financial support for reprinting the out of print books of the Society—CIRCUMVENTING THE MAHSEER AND OTHER SPORTING FISH IN INDIA AND BURMA, SOME BEAUTIFUL INDIAN TREES and SOME BEAUTIFUL INDIAN CLIMBERS AND SHRUBS—but as yet it has not been possible to make a start.

General

Bird Migration Study : The migration studies of birds have been extended to cover almost all parts of the country, and the work is now being done on an all-year basis. This has been possible because of financial assistance from the Smithsonian Institution, Washington and the Migratory Animal Pathological Survey of the U.S. Army.

Additions to the Collection : During the year 961 specimens were added to the collections :

Mammals	24
Birds	883
Reptiles and Amphibians ..	41
Fishes	3
Invertebrates	10

Conservation : The Society has made every effort to impress the Central and State Governments through its representatives on the Indian Board for Wild Life and on the State Boards, with the need for more effective measures for wild life preservation.

Mainly at our instance, the Planning Commission called a meeting in August to consider the broad policies to be adopted during the Fourth Plan. It was agreed that an Assistant Inspector General of Forests should be appointed for looking after wild life affairs in the Ministry of Agriculture. It is fortunate that Government have at last prohibited the export of Tiger and Leopard skins, and the Society is pressing for plugging the loop-holes which still exist in this legislation.

The Society strongly supported a proposal to establish a Sanctuary for the remaining blackbuck in the Bhal area of Saurashtra, and we understand that the area is now being declared a sanctuary.

The Government of Maharashtra is taking steps to create a National Park in the Tulsi-Vihar area, and has appointed a Planning Board as well as an Advisory Board to assist it with the work of planning the National Park.

In the Karnala Bird Sanctuary in Kolaba District two rooms are being built to accommodate visitors who would like to spend the night in the forest, and small dams are being put up to impound the water of monsoon streams in the interests of wild life.

The Society is in close touch with the World Wildlife Fund Secretariat at Morges and with the International Union for Conservation of Nature and Natural Resources, and has done what it could to get financial and technical assistance for saving several of our endangered species such as the Swamp Deer in the Kanha National Park, and the Nilgiri Tahr in south India.

The illegal trapping of Game Birds by professional trappers continues to be a serious source of destruction in various states. There was a report from Mysore of large scale trapping of Partridges and Quails. In Maharashtra on one occasion more than 300 partridges and 500 quails were illegally caught by trappers, and this gives an indication of the magnitude of the problem. Representatives of the Society are in close touch with the Wild Life Preservation Officer and Chief Conservator of Forests, Maharashtra, both for improving the legislation and tightening its implementation.

One of the most important projects with which the Society was concerned this year was about setting up of a wild life research station in the Gir Sanctuary with the active assistance of the Smithsonian Institution, Washington and the Yale University, New Haven, U.S.A. The Gujarat Government has given its blessings to the scheme, and we hope that India's first wild life research station will be established soon with the co-operation of our Society.

The Society is co-operating with the Inspector General of Forests, Government of India, in connection with the arrangements for the IUCN General Assembly which takes place in New Delhi in November this year. It is hoped that a large number of our members will participate in the meetings at New Delhi, and also join in the post-Assembly tours to our Sanctuaries—information about which can be had from the Inspector General of Forests, Krishi Bhavan, New Delhi.

The Society deeply regrets the death of Mr. E. P. Gee, a member of its Advisory Committee for the past many years, and the foremost conservationist of this country. It records its great debt to him again for having donated to the Society his entire collection of books, transparencies and films ; some of which it is proposed to show on the occasion of the next Annual General Meeting.

The Society also records its regret on the death of Mr. J. L. Bernard, who so ably looked after its affairs as its representative in the U.K.

DONATIONS

Sálim Ali/Loke Ornithological Research Fund : During the year we received donations to the fund from :

The Chogyal of Sikkim	Rs. 300.00
Mr. R. E. Hawkins	Rs. 2,000.00
Dr. Sálim Ali	Rs. 1,000.00

The corpus of the fund now stands at Rs. 39,822.

Under the rules, the fund will become operative only after the corpus has attained the total of Rs. 1,00,000. We hope members and well wishers of the Society will help us in reaching this total in the shortest possible time.

Vertebrate Zoology Field Research Fund : We are glad to report that Mr. Humayun Abdulali has donated Rs. 10,000 with the object of encouraging field studies in Vertebrate Zoology.

Auditorium : During the year donations were received from Dr. T. H. Basset, Orchid Club of India and the Cactus Club of India, for purchasing chairs for the auditorium.

RESEARCH STUDIES

Dorabji Tata Grant for Field Work : Grants were made from the fund for field work on bats of Rajasthan, flora of Surat Dangs and biology of weaver birds in the Kumaon Terai.

Jawaharlal Nehru Memorial Trust Fellowship : We are glad to report that Mr. M. Krishnan who was recommended by the Society for a Fellowship for the study of the mammals of Peninsular India has commenced his work, and is expected to complete his survey within the next two years.

Bhutan Bird Survey : In September/December 1968, Dr. Sálim Ali, accompanied by assistants from the Society made another survey of birds in Bhutan. The party also ringed birds in the area for the bird migration study project.

Birds and Agriculture : Under the Council of Scientific and Industrial Research Scheme, one Junior Research Fellow commenced work during the year.

Nature Education Scheme

The scheme now in its 21st year, continues its activities in Bombay, Poona and adjacent areas for creating interest in nature among school children.

Library

During the year 72 books were added to the Library. Among these 26 were received for review, 28 purchased and 18 donated by members and others. Our thanks are due to the donors and to the publishers who have sent us review copies.

Meetings

On 25 January Mr. J. Willett spoke on 'Deer in the U.K.'; on 28 June Mr. M. Krishnan spoke on 'Photography'; on 30 August Mr. Richard St. Barbe Baker spoke on 'Arresting Deserts'; on 23 November Fr. H. Santapau spoke on 'Trees I have seen'; on 27 November Dr. A. N. D. Nanavati spoke on 'Animals in relation with man'.

Exhibitions

Between 29 January and 4 February an exhibition of Bird paintings by Shri Deoki Nandan Sharma was held; on 27 March the Orchid Club of Bombay in association with the Bombay Natural History Society held an exhibition of flowering orchids; on 30 March and 1 April the Cactus Club held an exhibition of cacti.

Revenue Account

The financial position of the Society continues to be difficult and even maintenance of routine activities puts the Society in difficult position.

Staff

The Committee wishes to record its appreciation of the willing co-operation of the entire staff in the activities of the Society.

Acknowledgement

The Committee's thanks are due to Mr. M. J. Dickins who continues to look after the Society's interests in the United Kingdom.

Registered No. F. 244 (BOM)

BOMBAY NATURAL HISTORY SOCIETY

THE BOMBAY PUBLIC TRUST ACT 1950

SCHEDULE VIII [VIDE RULE 17(1)]

BALANCE SHEET AS AT 31 *DECEMBER* 1968

FUNDS AND LIABILITIES	Rs. P.	Rs. P.	ASSETS	Rs. P.	Rs. P.
Trust Funds or Corpus :			*Immovable Properties :*		
Life Membership Fund :			*Motor Car :*		
Balance as per last Balance Sheet ..	85,714·28		Balance as per last Balance Sheet ..	31,883·44	
Add : Amount received during the year	2,594·12				
			Less : Depreciation during the year ..	6,376·69	
	88,308·40		*Furniture, Fixtures and Equipment :*		25,506·75
			Balance as per last Balance Sheet ..	62,175·79	
Less : Transferred to General Reserve Fund on account of written off Membership	36,765·40		Additions during the year ..	1,268·04	
				63,443·83	
		51,543·00	*Less :* Depreciation during the year ..	7,824·80	
Fixed Assets Fund :			*Investments:* (At cost)		55,619·03
Balance as per last Balance Sheet ..	89,411·07		Rs. 5,000 4% Bombay Port Trust Bonds 1908 ..	3,850·00	
Add : Grants and donations received ..	799·54		Rs. 25,000 3% Conversion Loan 1946/86.	25,000·00	
	90,210·61		Rs. 30,000		
Less : Transferred to Income and Expenditure Account on account of Depreciation	14,201·49				
		76,009·12			
Carried forward ..		1,27,552·12	Carried forward ..	28,850·00	81,125·78

BALANCE SHEET AS AT 31 DECEMBER 1968—(*continued*)

FUNDS AND LIABILITIES	Rs. P.	Rs. P.
Brought forward ..		1,27,552.12
Provision for Capital Losses :		
Balance as per last Balance Sheet ..	838·38	
Add : Transferred from Income and Expenditure Account ..	2,552·50	3,390·88
General Reserve Fund :		
Transferred from Life Membership Fund		36,765·40
Building Fund :		
Balance as per last Balance Sheet ..	19,600·76	
Less : Transferred to Income & Expenditure Account on account of Expenses on leasehold building ..	450·00	19,150·76
Publication Fund :		
Balance as per last Balance Sheet ..		30,725·00
Other Earmarked Funds :		
(As per Schedule 'A') ..		77,940·96
Carried forward ..		2,95,525·12

ASSETS	Rs. P.	Rs. P.
Brought forward ..		81,125·78
Investments: (At cost) Brought forward		
Rs. 30,000 ...	28,850·00	
Rs. 2,000 3% 1st Development Loan 1970/75 ..	1,948·75	
Rs. 32,000 (Market value Rs. 21,519).	30,798·75	
Rs. 3,000 12 Year National Defence Certificates due 22-10-1975	3,000·00	
Rs. 35,000 ..	33,798·75	
Less : Provision for Depreciation ..	6,750·00	27,048·75
Loans : (Unsecured, considered good)		
Loan Scholarships ..	—	
Other Loans (to staff) ..	230·00	230·00
Advances : (Considered good) ..		
To Trustees ..	—	
,, Employees (for camp expenses)	763·67	
,, Others ..	1,013·96	1,777.63
Carried forward ..		1,10,182·16

BALANCE SHEET AS AT 31 *DECEMBER* 1968—(*continued*)

FUNDS AND LIABILITIES	Rs. P.	Rs. P.
Brought forward ..		2,95,525·12
Liabilities		
For Expenses	71,369·51	
,, Advance Subscriptions ..	680·50	
,, Sundry Credit Balances ..	1,192·20	
		73,242·21
Carried forward ..		3,68,767·33

Notes.—

(1) Included in the Fixed Assets is a Filing Cabinet amounting to Rs. 743.04 which has been purchased out of the Grants from the U.S. Government (Army) for Migratory Animal Pathological Survey.

(2) All expenses incurred on the various activities for which grants and donations are received have been directly debited to the relevant Fund Account.

(3) Annual subscriptions are accounted for on a cash basis. The amount due as at 31st December, 1968 from Members is not ascertainable.

ASSETS	Rs. P.	Rs. P.
Brought forward ..		1,10,182·16
Stocks: (At cost or under)		40,406·49
Income Outstanding:		
Rent	—	
Interest (Accrued)	3,850·53	
Other Income:		
Supplies and Services	31,175·88	
Government of India		
Grant for Journal Expenses 1968-69.	8,000·00	
National Institute of Sciences:		
Grant for Journal Expenses 1968-69.	1,000·00	
Cash and Bank Balances:		44,026·41
(*a*) In Current Account with:		
National & Grindlays Bank Ltd., Bombay. ..	1,035·97	
National & Grindlays Bank Ltd., London (£271-15-5) ..	4,891·88	
Chartered Bank, Bombay ..	2,023·81	
In fixed Deposit with:		
National & Grindlays Bank Ltd., Bombay	60,000·00	
Bank of India Ltd., Bombay (including Rs. 36,000 for Sálim Ali/Loke Wan Tho Ornithological Research Fund and Rs. 3,000 for Col. Burton's Nature Conservation Fund) ..	39,000·00	
Chartered Bank, Bombay ..	10,000·00	
Carried forward ..	1,16,951·66	1,94,615.06

BALANCE SHEET AS AT 31 DECEMBER 1968—(*continued*)

FUNDS AND LIABILITIES	Rs. P.	Rs. P.	ASSETS	Rs. P.	Rs. P.
Brought forward ..		3,68,767·33	Brought forward ..	1,16,951·66	1,94,615·06
			M/s. Mukund Iron & Steel Co. Ltd., Bombay ..	10,000·00	
			(*b*) With the Trustees ..	—	
			(*c*) With the Cashier ..	465·01	
					1,27,416·67
			Income and Expenditure Account		
			Balance as per last Balance Sheet ..	25,557·67	
			Add : Deficit from Income and Expenditure Account ..	21,177·93	
					46,735.60
Total ..		3,68,767·33	Total ..		3,68,767·33

The above Balance Sheet to the best of my belief contains a true account of the **Funds** and Liabilities and of the Property and Assets of the Trust.

BOMBAY, 23*rd June*, 1969

(Sd.) J. D. KAPADIA,
Trustee

As per our report of even date
(Sd.) A. F. FERGUSON & Co.,
Chartered Accountants

Registered No. F. 244 (BOM)

BOMBAY NATURAL HISTORY SOCIETY, BOMBAY-1

THE BOMBAY PUBLIC TRUST ACT 1950

SCHEDULE IX [VIDE RULE 17(1)]

INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31 DECEMBER 1968

EXPENDITURE	Rs. P.	Rs. P.
To Expenses in respect of properties :		
Rates, Taxes, & Cesses ..		nil
Repairs, and Maintenance ..		nil
Salaries		nil
Insurance		nil
Depreciation (by way of provision or adjustments)		nil
,, *Expenditure from Grants from Government of Maharashtra :*		
For 1967-68 : Salaries (Per contra) ..	10,540·16	
For 1968-69 : Salaries (Per contra) ..	23,124·64	
For 1968-69 : Building Maintenance (Per contra)	3,236·62	
		36,901·42
Carried forward ..		36,901·42

INCOME	Rs. P.	Rs. P.
By Rent :		
Accrued	nil	
Realized	nil	
		nil
,, *Interest* (Accrued and Realized)		
On Securities	1,304·00	
On Bank Account (Fixed Deposits) ..	3,947·74	
		5,251·74
,, *Dividends :*		nil
,, *Donations :*		
In cash	nil	
In kind—Coloured transparencies; Library books, Photographs etc. received from the Estate of Late Dato Loke Wan Tho not valued..	nil	
		nil
,, *Grants :*		
Government of Maharashtra :		
For 1967-68 (Expended as per contra)	10,540·16	
For 1968-69 (Expended as per contra)	23,124·64	
For 1968-69 (Expended as per contra)	3,236·62	
Educational Activity Grant 1968-69..	4,000·00	
Carried forward	40,901·42	5,251·74

INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31 DECEMBER 1968—(*continued*)

EXPENDITURE	Rs. P.	Rs. P.
To Brought forward ..		36,901·42
Establishment Expenses :		
Salaries including Dearness Allowance	45,711·65	
Society's contribution to Staff Provident Fund	2,455·41	
Postages	1,803·01	
Printing and Stationery	1,689·63	
Advertisements	213·68	
Telephone Charges	377·40	
Bank Charges	485·02	
Meeting Expenses	1,189·21	
Motor Car Charges	582·32	
Conveyance and Travelling Expenses	116·70	
Expenditure on Leasehold Building (As per contra)	450·00	
Rent	1·00	
		55,075·03
To Miscellaneous Expenses :		
General Charges	1,810·92	
Fire and Equipment Insurance ..	185·40	
Repairs to Furniture	357·87	
Field Trip Expenses	68·72	
		2,422.91
,, Remuneration to Trustees ..	nil	
Remuneration (In the case of Math)	nil	
Legal Expenses	nil	
Audit Fees	1,000·00	
Contribution and Fees	nil	
		1,000·00
Carried forward ..		95,399·36

INCOME	Rs. P.	Rs. P.
Brought forward ..	40,901·42	5,251·74
By Grants: (contd.)		
Government of India :		
For Journal Publication Expenses 1968-69	8,000·00	
National Institute of Sciences :		
For Journal Publication Expenses 1968-69	1,000·00	
		49,901·42
,, *Income from Other Sources :*		
Membership Subscriptions ..	26,268·56	
Entrance Fees	395·00	
		26,663·56
,, *Publications :*		
Journal Sales	3,629·64	
,, *Profit on sale of Books :*		
Book of Indian Birds ..	5,319·29	
Some Beautiful Indian Trees ..	15·00	
Butterflies of the Indian Region ..	1,923·40	
Book of Indian Animals ..	5,666·92	
Indian Molluscs	203·82	
Identification of Poisonous snake charts	186·00	
Handbook of the Birds of India and Pakistan Vol. I	1,388·88	
Identification of Butterflies by Evans	10·00	
Other Publications	111·50	
Nature Calendars	1,669·75	
Carried forward ..	20,124·20	81,816·72

INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31 *DECEMBER* 1968—*(continued)*

EXPENDITURE		Rs. P.	Rs. P.
Brought forward ..			95,399·36
To Amounts Written off :			
(*a*) Bad Debts		332·91	
(*b*) Loan Scholarships		nil	
(*c*) Irrecoverable Rent		nil	
(*d*) Other Items		nil	
			332·91
,, *Depreciation :*			
On Investments		nil	
On Furniture		7,824·80	
On Motor Cars		6,376·69	
			14,201·49
,, *Expenditure on Objects of the Trust :*			
(*a*) Religious		nil	
(*b*) Educational—Journal Expenses (including Index)		33,146·37	
—News Letter ..		1,042·45	
,, *Library Account :*			
Subscription to other Societies ..	1,480·39		
Purchase of Books ..	412·37		
Periodicals and Binding charges	499·50		
		2,392·26	
			36,581·08
,, *Maintenance of Reference Collections* ..			1,888·40
Total ..			1,48,403·24

INCOME	Rs. P.	Rs. P.
Brought forward ..	20,124·20	81,816·72
Profit on sale of Books (contd.)		
Add : Profit on packing and forwarding charges ..	85·75	
		20,209·95
By Miscellaneous Receipts: (including 5% administrative charges on the expenses of various grants handled during the year and reimbursement of salaries on field staff loaned for Bird Migration Study camps) ..		10,547·15
,, Profit made on Investments matured	2,552·50	
Less : Transferred to Provision for Capital losses ..	2,552,50	
		nil
,, *Transfers :*		
From Fixed Assets Fund on account of Depreciation (as per contra)		14,201·49
From Building Fund on account of expenses on Leasehold Building (as per contra)		450·00
,, Deficit for the year carried to Balance Sheet		21,177·93
Total ..		1.48,403·24

As per our report of even date.
(Sd.) A. F. FERGUSON & Co.,
Chartered Accountants

BOMBAY, 23rd June, 1969

(Sd.) J. D. KAPADIA,
Trustee

BOMBAY NATURAL HISTORY SOCIETY

SCHEDULE FORMING THE PART OF THE BALANCE SHEET AS AT 31 *DECEMBER* 1968

Name of the Fund/Grant (1)	*Balance as per last Balance Sheet* (2)	*Additions/ Amounts received during the year* (3)	*Transfers from other Funds* (4)	*Total of columns 2, 3, & 4* (5)	*Spent/ Refunded* during the year* (6)	*Transfers to other Funds* (7)	*Total of columns 6 & 7* (8)	*Balance as at 31st December 1968 (minus) (5-8)* (9)
(1) Field Work Fund ..	1,689·64	..	..	1,689·64	650·00	..	650·00	1,039·64
(2) Staff Welfare Fund ..	500·00	..	..	500·00	..	..	..	500·00
(3) Dr. Sálim Ali/Loke Wan Tho Ornithological Research Fund	35,074·60	4,748·30 (including interest earned Rs. 1,448·30)	..	39,822·90	..	..	..	39,822·90
(4) Col. Burton's Nature Conservation Fund ..	3,433·88	189·00	..	3,622·88	..	..	..	3,622·88
(5) Grant from California Academy of Sciences for Herpetological Survey ..	2,202·92	..	..	2,202·92	351·48	..	351·48	1,851·44
(6) Vertebrate Zoology Field Work Fund (By Shri Humayun Abdulali) ..	..	11,011·82 (including interest earned Rs. 1,011·82)	..	11,011·82	..	..	..	11,011·82
(7) Grant from Government of Bhutan for the Survey of Birds to Dr. Sálim Ali ..	..	8,000·00	4,677·78*	12,677·78	12,677·78	..	12,677·78	..
(8) Grant from Smithsonian Institution for the Secretarial Assistance to Dr. Sálim Ali on the Publication of Hand-book of the Birds of India and Pakistan in Five Volumes ..	11,572·91	..	416·44 Ad.B.N.H.S.	11,989·35	11,989·35	..	11,989·35	..
Carried forward ..	54,473·95	23,949·12	5,094·22	83,517·29	25,668·61	..	25,668·61	57,848·68

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Brought forward Rs. ..	54,473·95	23,949·12	5,094·22	83,517·29	25,668·61	..	25,668·61	57,848·68
(9) Grant from Seth Purushottamdas Thakurdas and Divaliba Charitable Trust for the Publication of Nature Study booklets for Free Distribution ..	10,121·94	..	..	10,121·94	7,319·78	..	7,319·78	2,802·16
(10) Grant from Smithsonian Institution for the Bird Migration Study Survey ..	21,456·22	..	..	21,456·22	21,153·16	..	21,153·16	303·06
(11) Grant from U.S. Government (Army) for Migratory Animal Pathological Survey ..	34,077·31	..	..	34,077·31	26,511·21	4,677·78	31,188·99	2,888·32
(12) Grant from Government of India for the publication of Handbook of the Birds of India and Pakistan in Five Volumes 1967-68 ..	9,000·00	..	..	9,000·00	8,854·28 *145·72 (Refunded)	..	9,000·00	..
(13) Grant from Government of Maharashtra : Grant of 1967-68 : (*i*) For Establishment expenses ..	11,613·84	..	..	11,613·84	10,540·16 *1,073·68 (Refunded)	..	11,613·84	..
(*ii*) Grant for the year 1968-69 : (*a*) For Establishment expenses ..	..	34,460·00	..	34,460·00	23,124·64	..	23,124·64	11,335·36
(*b*) For Building Maintenance ..	..	6,000·00	..	6,000·00	3,236·62	..	3,236·62	2,763·38
Total ..	1,40,743.26	64,409·12	5,094·22	2,10,246·60	1,27,627·86	4,677·78	1,32,305·64	77,940·96

*The above amounts being unspent have been refunded to the relevant Government Authorities.

BOMBAY NATURAL HISTORY SOCIETY

NATURE EDUCATION SCHEME

Receipts and Payments Account for the Year ended 31 *December* 1968

RECEIPTS	Rs. P.	Rs. P.
To Balance as at 1st January, 1968 brought forward :		
Cash with Cashier	50·00	
Balance with National & Grindlays Bank Ltd., Bombay on Current Account	743·91	
Balance with Bombay Natural History Society	31·57	825·48
,, Grant from Government of Maharashtra :		
for 1967-68		9,140·00
for 1968-69		8,840·00
,, Sales of Nature Study Booklets ..		275·59
Total ..		19,081·07

PAYMENTS	Rs. P.	Rs. P.
By Salary of Nature Education Organiser		7,854·00
,, Printing and Stationery ..		1,024·61
,, General Charges		765·63
,, Postages		301·15
,, Balance as at 31st December, 1968		
Cash with Cashier	42·40	
On Current Account with National & Grindlays Bank Ltd., Bombay	9,034·49	9,076·89
,, Balance from Bombay Natural History Society carried forward ..		58·79
Total ..		19,081·07

BOMBAY, 23*rd June*, 1969

(Sd.) A. F. FERGUSON & Co.,
Chartered Accountants.

(Sd.) J. D. KAPADIA,
Trustee.

BOMBAY NATURAL HISTORY SOCIETY

COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH GRANT-IN-AID

Receipts and Payments Account for the Year ended 31 *December* 1968

RECEIPTS	Rs. P.	PAYMENTS	Rs. P.	Rs. P.
To Balance as at 1st January, 1968 brought forward : With National & Grindlays Bank Ltd., Bombay on Savings Account	5,239·34	By Grant for Study of Sea-anemones of Maharashtra 1968-69 :		
		Salaries	6,000·00	
		Miscellaneous	2,144·05	8,144·05
,, Grant for Study of Sea-anemones of Maharashtra 1968-69	5,643·95	,, Grant for Study of the Ecology of Avian Species of importance to Indian Agricultural Economics 1968-69 :		
,, Grant for Study of the Ecology of Avian Species of importance to Indian Agricultural Economics 1968-69	4,063·95	Salaries	3,600·00	
		Miscellaneous	2,063·95	5,663·95
,, Interest on Bank Account	66·00	,, Balance as at 31st December, 1968 : With Junior Fellow (Mr. D. N. Mathew) ..	500·00	
		On Savings Bank Account with National & Grindlays Bank Ltd., Bombay	705.24	1,205·24
Total ..	15,013·24	Total ..		15,013·24

BOMBAY, 23*rd June*, 1969

(Sd.) A. F. FERGUSON & Co.,
Chartered Accountants.

(Sd.) J. D. KAPADIA,
Trustee.

MINUTES OF THE ANNUAL GENERAL MEETING OF THE BOMBAY NATURAL HISTORY SOCIETY HELD AT HORNBILL HOUSE, SHAHID BHAGAT SINGH ROAD, BOMBAY 1, ON FRIDAY, 22ND AUGUST, 1969, AT 6-30 P.M., WITH FR. H. SANTAPAU, S.J. IN THE CHAIR. APPROXIMATELY 75 MEMBERS AND GUESTS WERE PRESENT

1. The Chairman first asked the Honorary Secretary to present the report for the year ; but as the latter was in the hands of members, the Honorary Secretary referred to the more important aspects of the Annual Report. The Honorary Secretary said that the Indian Board for Wild Life, on which the Society was very strongly represented, had met last month after 5 years. Dr. Karan Singh, the new chairman of the Board, appeared to be serious about taking effective steps for saving our vanishing wild life. After the meeting of the IBWL, the Prime Minister addressed an excellent letter to the Chief Ministers of all the States drawing their attention to the importance of following up the Resolutions of the Board. Portions of the letter from the Prime Minister were read out at the meeting.

The Honorary Secretary also referred to the Gir project which was a joint enterprise between the Smithsonian Institution, Yale University, the Government of Gujarat and the Bombay Natural History Society. The grant of Rs. 4.74 lakhs from PL 480 Funds was sanctioned by the Ministry of Finance, and it was expected that steps would be taken soon to start with the work in the Gir.

The Honorary Secretary referred to the need for more members, and requested everyone present to make efforts to enrol at least one new member by the time of the next meeting.

The Chairman then asked members if they would like to make any suggestion. Mr. Bansi Mehta suggested that the Society should play a greater part in awakening interest in wild life and nature conservation in schools and colleges. The Chairman referred to the Nature Education Scheme of the Society and said that it would certainly do everything possible to create an interest among young people. Dr. A. N. Tyabji proposed and Mr. F. C. Badhwar seconded that the Report of the Committee be adopted. The proposal was accepted unanimously.

2. The Chairman asked the Honorary Treasurer to present the accounts. The Honorary Treasurer said that the Society had incurred a deficit of approximately Rs. 20,000 during the year, and this was mainly due to the fact that there was a break in the sales of publications. The sale of books really accounted for the profit of the Society. He hoped, however, that in the coming months the position would improve. Mr. D.

J. Panday proposed and Mr. V. M. Vasu seconded that the statement of accounts be adopted. The proposal was carried unanimously.

3. The Chairman stated that since there were no other candidates apart from those proposed by the Committee, the panel of persons nominated by the Executive Committee were deemed to be elected on the Executive and Advisory Committees of the Society for the current year without any balloting.

EXECUTIVE COMMITTEE

President

Dr. P. V. Cherian, *Governor of Maharashtra*

Vice-Presidents

Major-General Sir Sahib Singh Sokhey, I.M.S. (Retd.)
Dr. Sálim Ali, D.SC., F.N.I.
Rev. Fr. H. Santapau, S.J.

Hon. Secretary

Mr. Zafar Futehally

Hon. Treasurer

Mr. J. D. Kapadia, I.C.S. (Retd.)

Member

Secretary, Ministry of Education, Govt. of India

ex-officio

Elected Members

Mr. Humayun Abdulali
Mr. G. V. Bedekar, I.C.S. (Retd.)
Prof. P. V. Bole
Mr. S. Chaudhuri
Mr. R. E. Hawkins
Dr. C. V. Kulkarni, M.SC., Ph.D.
Mr. Duleep Matthai
Dr. A. N. D. Nanavati, M.D.
Mr. D. J. Panday
Mr. D. E. Reuben, I.C.S. (Retd.)

ADVISORY COMMITTEE

Mr. H. G. Acharya	*Ahmedabad*
Mrs. Jamal Ara	*Ranchi*
Mr. F. C. Badhwar, O.B.E.	*New Delhi*
Sir Chintaman Deshmukh, Kt., C.I.E., I.C.S. (Retd.) ..	*Hyderabad*
Mr. A. K. Ghosh, I.C.S. (Retd.)	*New Delhi*
Mr. M. Krishnan	*Madras*
Mr. M. J. S. Mackenzie	*Assam*
Dr. N. K. Panikkar, M.A., D.SC., F.N.I.	*Panaji*
Mr. P. D. Stracey, I.F.S.	*New Delhi*

4. The Honorary Treasurer referred to the need for amending Rule 7 of the Rules & Regulations of the Society to enable its funds to be invested in securities other than Government Securities. The proposal was that after the word Government in line three of Rule 7, the words ' or other ' shall be inserted. The sentence will then read as follows :

' The capital obtained from Life Membership Contributions and Compounded Subscriptions shall not be used as revenue, but shall be invested in Government or other Securities and the interest thereon only utilised as revenue '.

The proposal was unanimously approved.

The meeting terminated with a vote of thanks to the Chair. Thereafter, there was a slide show of the colour transparencies by Mr. E. P. Gee. The show was greatly appreciated and members expressed their admiration for the work done by the late Mr. E. P. Gee in the cause of wild life preservation in India, and for his generosity in having donated all his films, slides, manuscripts, books, etc., to the Society.

Notes and News

Fourteenth International Congress of Entomology

The 14th International Congress of Entomology will be held in Canberra, Australia, from 22nd to 30th August, 1972.

The Congress will be divided into Sections covering the following fields : Taxonomy ; Morphology ; Zoogeography ; Palaeontology ; Genetics ; Physiology, Cytology and Fine Structure ; Behaviour ; Biochemistry ; Ecology ; Biological Control and Insect Pathology ; Non-Insecticidal Control ; Population Management and Integrated Control ; Toxicology, Resistance and Side Effects of Insecticides ; Medical and Veterinary Entomology ; Agricultural Entomology ; Forest Entomology ; Stored Products Entomology ; Tropical Entomology.

There will also be Symposia covering a wide range of topics. Arrangements are being made for pre-, post- and in-Congress tours of entomological, scenic and historical interest.

A preliminary circular giving information on the Congress will be issued in May, 1970. Anyone wishing to receive this circular should write to the Secretary of the Congress, who will be pleased to answer enquiries. The address is :—Mr. C. N. Smithers, Secretary, 14th International Congress of Entomology, The Australian Museum, 6-8 College Street, Sydney, N.S.W., Australia, 2000.

ERRATA

Volume 66(2) : August 1969

Page 327, para 3, line 5
for 676 read 696

Page 331, para 1, line 4
for 2.0 read 2.1
para 5, line 4
for 'three per mile or one per 5.5 acres' read '3.1 per mile or one per 5.3 acres'.

Page 332,
replace existing Table 2 with

TABLE 2

NUMBERS OF INDIVIDUAL SPECIES SEEN IN DIFFERENT HABITATS

Species	Status	Stony Jol 119 miles	Earth Jol 205 miles	Wadi beds 89 miles	Total 413 miles
Corvus corax ruficollis	R	13	3	2	18
Certhilauda alaudipes	R	—	20	—	20
Eremopterix nigriceps	R	—	15	—	15
All other larks (3+spp.) including	R and M	81	95	54	230
Ammomanes deserti (66%)	R	54	63	36	153
Lanius excubitor	R	—	1	8	9
Pycnonotus capensis	R	—	—	7	7
Turdoides squamiceps	R		—	20	20
Oenanthe deserti	M	10	19	14	43
Oenanthe leucomela	M	—	1	5	6
Cercomela melanura	R	5	—	20	25
Hirundo domestica	M	—	2	—	2
Merops superciliosus	M	—	—	6	6
Falco tinnunculus	M	1	—	—	1
Buteo rufinus	M	1	—	—	1
Neophron percnopterus	M	2	11	3	16
Pterocles exustus	R	—	118+	30	148+
Chlamydotis undulata	R	—	—	1	1
Ammoperdix heyi	R	1	2	69	72
Unidentified (mainly small warblers, 4-5 species).	R and M	2	16	38	56
Total		116	303	277	696
Number of sp. minimum		12	14	16	20
probable		13	16	20	25
Species not seen in other habitats		2	3	4	

Notes (1) Of two species found only in Stony Jol (Kestrel and Buzzard) both were probably fortuitous ; of three found in Earth Jol one (Swallow) was fortuitous ; but all four species found only in Wadi Beds are confined to that habitat.

(2) The number of species of unidentified small warblers was greater in the thick cover of Wadi Beds than in Stony Jol, where few were seen.

(3) Under Status, R=Resident, M=Migrant.

Page 333, para 4, line 7
for 100 : 200 read 1 : 200

Page 337, item (4) of summary, line 2
for 676 read 696

Page 399, last para,
for *Actinocumis typica* read *Actinocucumis typica*

Page 400, first entry under genus *Holothuria*
for *Holothuria ocellata* Jaeger read *Holothuria atra* Jaeger

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THE SOCIETY'S PUBLICATIONS

Birds

The Book of Indian Birds, by Sálim Ali. 8th (revised) edition. 66 coloured and many monochrome plates. **Rs. 25**

(*Price to members Rs.* 20)

Snakes

Identification of Poisonous Snakes. Wall chart in English, Gujarati, and Marathi. **Rs. 10**

(*Price to members Rs.* 8)

Miscellaneous

Picture Postcards of 12 representative Indian Birds (In colour) per set **Rs. 2·50**

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1. OUR BIRDS I (with 8 coloured plates) in Hindi, and Marathi. **Rs. 0·80**
   Kannada **Rs. 0·62**
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3. OUR BEAUTIFUL TREES (with 8 coloured plates) in Hindi and Marathi **Rs. 0·62**
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5. OUR ANIMALS (with 8 coloured plates) in English, Gujarati, Hindi, and Marathi. **Rs. 1·25**

Back numbers of the Society's Journal. Rates on application.

Correspond with :

The Honorary Secretary,
Bombay Natural History Society,
Hornbill House, Shahid Bhagat Singh Road, Bombay 1-BR.

Agents in England :

Messrs Wheldon & Wesley Ltd.,
Lytton Lodge, Codicote, Near Hitchin,
Herts, England.

The Society will gratefully accept back numbers of the *Journal*, particularly numbers prior to Vol. 45, from members who may not wish to preserve them.

TERMS OF MEMBERSHIP

Life Members pay an entrance fee of Rs. 5 (5 *sh.*) and a life membership fee of Rs. 600 (Inland), £45-10-0 (Foreign).

Ordinary Members pay an entrance fee of Rs. 5 (5 *sh.*) and an annual subscription of Rs. 36 (Inland), £3 (Foreign).

Members residing outside India should pay their subscription by means of orders on their Bankers to pay the amount of the subscription to the Society in Bombay on the 1st January in each year. If this cannot be done, then the sum of £3-0-0 should be paid annually to the Society's London Bankers—The National & Grindlays Bank Ltd., 23 Fenchurch Street, London E.C. 3.

The subscription of members elected in October, November, and December covers the period from the date of their election to the end of the following year.

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